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ABSTRACT

The 3-month study of the role of microcomputers in schools described in this report focuses on the six New England States and New York State. The report covers (1) instructional software available for the most frequently used microprocessors (including samples from several regions); (2) production of a resource listing of instructional courseware according to computer type, program language, grade level, objectives of the instructional program, location, cost, and source (see appendices for software bibliography); (3) examples of current school applications and the roles of microprocessors within the seven participating states; (4) identification of at least 10 locations where schools have successfully integrated the use of "personal computers" in the K-12 curriculum; (5) identification of policies or program procedures being used by various states to control or assist in the purchase of hardware; and (6) the development of a data bank of educational software and user evaluations of software on a commercial time-shared system. Included in the appendices are a software bibliography, a description of hardware available to schools, sample programs, addresses of organizations concerned with microcomputers and education, state survey reports, and program listings. (BK)

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MICROCOMPUTERS IN EDUCATION

"Applications of Microprocessors in the Schools"

A Report to the

Northeast Regional Education Planning Project

May 15, 1980

Technical Education Research Centers, Inc.
8 Eliot Street
Cambridge, Massachusetts 02138

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Adeline Naiman

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

The work contained herein has been developed pursuant to a contract with the Northeast Regional Education Planning Project.

IR009110

NOTE

This report was prepared by Robert Tinker and Adeline Naiman. Software was coordinated by Richard Kane. Program listings are not bound into this copy of the report for reasons of space and cost. For information on program listings from the NREPP report, please write TERC, 8 Eliot Street, Cambridge, MA 02138. Visitors are welcome to examine the listings at TERC.

NORTHEAST REGIONAL EDUCATION PLANNING PROJECT:

APPLICATIONS OF MICROPROCESSORS IN THE SCHOOLS

In February 1980, Technical Education Research Centers, Inc. (TERC) was given a small contract for a three-month study of the role of microcomputers in the schools of the Northeast region--the six New England states and New York. The tasks specified were these:

A. Sample national, regional and state availability of existing instruction courseware for the most frequently use microprocessors. (p. 2)

B. Produce a resource listing of instructional courseware, according to computer type, program language, grade level, objectives of instructional program, location, cost, and how to obtain. (p.16)

C. Document examples of current school applications and roles of microprocessors within the seven participating states. (p. 25)

D. Identify at least 10 locations where schools have successfully integrated the use of "personal computers" in the K-12 curriculum, particularly in the Northeast region. (p. 44)

E. Nationally, identify policies or program procedures that are being used by states to control or assist in the purchase of hardware. (p. 46)

F. Begin development of a data bank of educational software and user evaluations of software on a commercial time-shared system. (p. 49)

The present report represents our findings over the three months ending May 15, 1980. We view it as only the beginning of a systematic study of the practices and issues relating to this mushrooming phenomenon. Microcomputers seem to carry for teachers and students and administrators alike a refreshing and motivating energy missing from the school scene for a decade or more. Spreading through informal networks, as well as formal school structures, microcomputer education offers hope of meeting many educational and societal needs if the power of the medium is thoughtfully and imaginatively used. While our report could only skim the surface of what is out there, we hope it will offer an introduction to this new, peaceful revolution.

MICROCOMPUTER EDUCATIONAL SOFTWARE

A. Sample national, regional, and state availability of existing instructional courseware for the most frequently used microcomputers.

This section gives a sample of existing instructional software used on the most popular microcomputers and addresses both the present and future availability of similar software nationally, regionally, and within the Northeastern states. After some preliminary remarks about the technology and the nature of the field, we will describe several instructional programs and present detailed information about how to obtain educational software.

Some preliminaries

Our first task is to define the most frequently used microcomputers. Spotty surveys confirm the perception gained through extensive personal contacts that the Commodore PET and the Tandy Radio Shack TRS-80 are the most popular at the primary and middle schools while the Apple Computer Company's Apple II, also marketed by Bell & Howell, sees wide use in high schools. Because of the preeminent position of these computers, this report focuses on issues concerning them. Occasional mention is made of other computers that we have found in schools: the Compucolor, the Commodore KIM-1, the Rockwell AIM-65 and S-100/CPM machines. Descriptions of all these microcomputers are found in the Appendix.

The task statement for this section refers to the geographic availability of software. Because of the nature of the present software distribution system, this did not seem to be a useful organizing principle for the report. Published software, both commercial and from nonprofits, is available nationally and distributed from numerous outlets in the Northeast; shared software is available locally wherever there are computer clubs and organizations. Because the way educational software is generated determines how and where it

is available, this section is divided according to this criterion. A discussion of the educational institutions and related groups distributing educational software is postponed to a later section of this report.

Finally, let us clear up some possible confusion about vocabulary:

- A microcomputer is a complete computer system with output and memory based on a microprocessor.
- A microprocessor is a single integrated circuit containing all the primary logic and control elements needed in a computer.
- An integrated circuit is a single wafer of silicon fabricated to contain a functioning array of transistors and other electronic devices.
- CAI stands for computer-assisted instruction and has as many connotations as authors. We have accepted the common definition limiting it to classic programmed instruction delivered by a computer.
- Courseware is a term coming into use to distinguish material used in a course (often called software) from programs that computers execute (also called software); we prefer to call it course material or curriculum material.

Some exemplary programs

Educational software is available for a range of commercial microcomputers, serving a variety of educational levels, objectives, subject areas, and teaching styles. To give readers a taste of what is currently available to educators in the Northeast region, we have selected a number of exemplary programs. These programs are described briefly below and more fully in the Appendix. They were chosen so that the group as a whole is representative; they are not necessarily the best programs, not do they exhaust all the educational applications of microcomputers.

Buggy is a clever program that makes a game of finding the computer's arithmetic mistakes. It can be used in grades 4-8 with an Apple II.

Star Trader generates a model that has students trading commodities on a cosmic scale. It can be used in grades 7-11 on a Compucolor in social

science courses.

Three Mile Island simulates the operation and occasional failure of a nuclear-power generating plant. Students from 4th to 12th grades learn technical and economic skills by manipulating this Apple II program.

IQ Builder is a series of drill-and-practice programs useful for many language arts skills in grades 8-11. Versions are available for all the popular microcomputers.

The Milliken Math Package is a large, branching CAI package of math programs that teaches basic skills in grades 1-6. It is available for all the popular machines.

Lemonade Stand is a simple economics modeling program from which students in grades 4-8 can learn how supply and demand might affect their lemonade sales. Versions for the TRS-80 and Apple are available.

Hangman is a universally available computer adaptation of this children's game used in grades 1-8 to teach spelling and problem solving.

Typing Tutor uses the computer to improve typing skills. It is available on the Apple and TRS-80 and can be used in any grades for teaching typing.

The Exponential Function uses numerous examples to show in graphic detail on a Compucolor the range of factors in our culture that are increasing exponentially. As such, it is a sobering lesson in ecology and mathematics for grades 10-14.

The Cooling Curve experiment illustrates how a microcomputer can be programmed to gather and analyze data in the laboratory. Available on the AIM-65 and KIM-1, this is useful in physical sciences in grades 8-12

Ghetto is a simulation program that forces high school level students to think about questions of values. It is available for all three popular microcomputers

GRASIC is a programming language that permits students to learn programming by using a "turtle" to create geometric figures. In the process, 6th-12th graders learn a range of programming, mathematics, geometry, and problem-solving concepts. Available on S-100/CPM machines.

Sources of software

There are four primary methods a teacher can use to obtain software: by writing software from scratch, by modifying existing software, by sharing software with other educational users, and by purchasing nationally distributed software. All of these techniques are important, and each should be evaluated for its appropriateness in a given educational setting.

Teacher-generated software

There are may reasons why a teacher might consider generating educational software. The most important is, perhaps, that by so doing the teacher has complete control over the content and style of the material presented. It may also be necessary because appropriate software is not available or because funds are not available to purchase software. Some teachers undertake software programming efforts because they want to learn the technology, explore its potential, and grow professionally.

The disadvantage of teacher-generated software, of course, is the time and technical expertise it takes to write good software. The amount of time and the level of expertise required depend on how the software is developed, the desired mode of presentation, and the educational objectives. As one might expect, a relatively routine program in a fixed format with little adaptability and simple machine communications is relatively easy to program,

while an attractive, adaptive program with good graphics requires great inventiveness and a large investment in time.

A number of approaches are available for generating educational software: one can use a general-purpose language, such as BASIC or FORTRAN; there are authoring languages especially adapted to the preparation of curriculum materials, such as PILOT*; and there are specific programs, such as Hangman and IQ Builder, that offer a learning context that can be adapted to the new material.

For all but the most trivial microcomputers, BASIC is the primary language for programming and, in some cases, the only available language. It is entirely feasible to write curriculum material in BASIC. It is a general-purpose language and, therefore, can be used in the specialized application of educational software. The language provides full control of the microcomputer and can be used in any way that is consistent with the available hardware. In fact, much of the educational course material currently available has been written in BASIC.

BASIC is easy to learn, partly because it was developed as a beginner's language for college students at Dartmouth. Many teachers with no previous programming experience have taught themselves BASIC on a microcomputer and have used their knowledge to begin to write educational software.

Other general-purpose languages that can be used to generate educational software are becoming available on microcomputers. In particular, PASCAL, because it has received strong support from the computer science community, is now available for the Apple, TRS-80, AIM, and S-100 systems, and will soon be available on most other machines.

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* Note: For further information about any of the languages and educational programs mentioned in the text, see the Software Bibliography in the Appendix.

PASCAL is harder for beginning programmers but for structural reasons requires less programming effort in large applications and can execute faster than BASIC. PASCAL is beginning to be used for computer-assisted instruction (CAI) at the college level, but because it places greater demands on hardware, will not be important at the precollege level for a few years.

A number of so-called authoring languages are now available for microcomputers. The most widespread of these is PILOT, which, in various forms, is available for the Apple, TRS-80, S-100, and Compucolor microcomputers. PILOT was developed as a means of providing branching programmed instruction in medicine, using large time-shared computers. It is designed to be used by educators who are not interested in learning the details of programming. As a result, it is quite simple, using only a handful of single-letter instructions. One advocate* claims that most teachers can learn to use the major facilities of PILOT in forty minutes of instruction.

PILOT generates classical CAI material. In a typical session using material authored by PILOT, the student is presented some material, asked some questions based on that material, and then transferred to another block of material based on the responses. PILOT provides the mechanism for easily generating material of this form; the content, richness of material, and accuracy of branching are entirely up to the author.

GENIS is a CAI-authoring language made available by Bell & Howell+ for the Apples that they market. It makes the preparation of PILOT-type material simpler by relieving the author of learning the codes associated with PILOT. Instead, it interactively prompts the author for the information the program

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* George Gerhold, Department of Chemistry, Western Washington State University, Bellingham, WA. Private communication.

+ Note: For addresses of any vendors, groups, or institutions mentioned in this report, see the comprehensive address list in the Appendix.

needs. GENIS-type authoring aids are said to be in final stages of preparation for the TRS-80 and Compucolor.

Authoring aids are currently limited to the preparation of branching and programmed instructional-type material. Other types of authoring aids have been developed for time-shared systems but are not currently available for commercial microcomputers.

Another type of educational-program development aid is the "Front End Package" now available for all three important microcomputers from CONDUIT. This program can be added to an educational program to record student use and achievement.

Another class of programs permit teachers to insert the content of their choosing within a particular context. Most drill-and-practice programs are of this category. Hangman is a computer adaptation of that classic guessing game, used to improve spelling. It is a simple matter to insert any vocabulary words into the program, thus adapting it to the needs of a particular teacher. Some programs, such as the Shell Games, are explicitly designed to permit the teacher insertion of relevant material; other programs must be modified to change the content. Even when modification is necessary, one should realize that it is much easier to modify someone else's program than to write it ab initio. From a listing of a complete Hangman program in BASIC, even a novice can pick out where the information originates for the words that the students will guess. By simply modifying those words while keeping the same syntax, someone who knows almost nothing about BASIC can insert a new vocabulary.

Transporting programs

People have been writing educational programs in BASIC for the last quarter-century and, as a result, an enormous literature has developed. There are, however, slight differences between BASICs, and so some programming

skill is required to adapt this literature to any one particular machine. Nevertheless, many of these programs are well worth the effort, and as mentioned in the previous paragraph, the programming effort required is less than that needed to write the program from scratch. In fact, much of the commercially available microcomputer software has been generated in this manner.

Three significant efforts in this area are based around materials found in three sources: the Huntington 2 project, the users' group supported by Digital Equipment Corporation, and CONDUIT. Each of these projects is a collection of educational software written primarily in BASIC, designed to run on large time-sharing systems and used by students at remote terminals.

The adaptation of these programs to specific microcomputers can take place in two stages. At the simplest level, the microcomputer can be used to function in exactly the way the terminal was originally designed to operate when the program was running on a time-share system. In many cases, this is quite satisfactory but doesn't take full advantage of a given microcomputer's special capabilities for graphics, color, sound, and other interactions. In some cases,such a direct translation is unsatisfactory because of the limitation of the size of the screen; the program may have been designed for a Teletype which may have more characters per line and is able to generate a very long roll of paper. Thus, a second level of adaptation may be necessary or simply desirable to improve the attractiveness of the program. In this case, the output and the interactiveness of the program are considerably modified to take advantage of a specific microcomputer and adapt the program to its limitations. This, of course, requires considerably more programming investment than the "terminal emulation" mode of adaptation.

Efforts are under way in numerous different centers to adapt public-domain

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software to various particular microcomputers. In fact, much of the low-cost educational software, such as that available through Project LOCAL,* is of this form. The low cost is not so much a reflection of the quality of the material as it is of the ease with which it can be adapted. The Huntington project material, in particular, is of extremely high educational value. Each program is a carefully thought through simulation of a particular situation and is supported by three written documents: student material, a teacher's guide, and implementation information.

Digital Equipment Corporation (DEC) supports an educational users' group called DECUS. One of their services is the support and maintenance of a large number of educational programs and games, many of which are quite good. While none of these are specifically adapted to microcomputers, the quality of their documentation makes such adaptation a relatively simple matter.

CONDUIT is a National Science Foundation (NSF)-supported project at the University of Iowa originally designed to share educational software among time-shared systems. CONDUIT offers an extensive catalog of shared programs, all of which are very well reviewed and documented. In addition, CONDUIT is beginning to adapt these programs to microcomputers so that many of them will soon be available for immediate use.

In addition, to Huntington, DECUS, and CONDUIT, there have been numerous other government-supported curriculum development projects that have yielded educational software that can be adapted to microcomputers.

Sharing programs

Up to this point, we have described software that requires teachers willing

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* A collaborative based in Westwood High School, Westwood, Massachusetts.

and able to write or modify programs. A far larger number of teachers have neither the time nor the inclination to do this and want programs that can be used without any programming effort. There are two major sources for this sort of software: user networks and national distributors.

There is no way to estimate with any precision the number of programs that are shared without cost between educators, but the number must be considerable. Teachers are an important part of most of the computer clubs and associations that have sprung up in most metropolitan areas. A partial list of such organizations with emphasis on the Northeast region is shown in Table 1. At a typical meeting of one of these associations, members bring their computers and recording material (tapes,disks, or punched paper tape) and trade programs. The same sort of thing goes on at the numerous computer conferences and meetings of professional associations. For instance, the Second Annual Lesley Conference on Computers, May 3, 1980, in Cambridge,Massachusetts, had a popular software-sharing session. These numerous ad hoc mechanisms have grown up because there is a great need; no one person or one group can possibly provide all of the imaginative and educationally valid programs for all the different computers in all the different disciplines at all the different grade levels.

The function of sharing programs is so important that it is beginning to be institutionalized within a wide variety of existing organizations. For example, the Boston Computer Society is organizing special-interest groups for each of the major microcomputers; the American Association of Physics Teachers at its meeting in Troy, New York, June 23, 1980, will have special interest groups for each of the commercial microcomputers; and the National Convention of Biology Teachers meeting in Boston, October 23-26, 1980, will have a session devoted to sharing programs. State educational agencies are launching formal

TABLE 1

NORTHEAST USER GROUPS

AC* ACM Association for Computing Machinery (National Society of professionals with many SIGs including SIGCUE: Computer Uses in Education) New York.

B1 Boston Computer Society/SIG: Education, Pet Users, Northstar Users, PASCAL/Source/Micronet Users, Boston 80 (TRS-80 Users), Apple Users, Monthly general meeting, bimonthly magazine - Boston Computer Update.

CU Computer Resource Center, Teachers College, Columbia University, program library.

T1 Computer Resource Center, TERC (Technical Education Research Centers, Inc.) program library, services, Cambridge, Massachusetts.

CE CERC (Computer Education Resource Coalition of five educational computing groups) Cambridge, Massachusetts.

DI DECUS (Digital Equipment Corporation Users Group) The largest pool of educational programs. Membership and services are free to educators. Marlboro, Massachusetts.

D3 Digital Group Users Group, Woodmere, New York.

L1 Project LOCAL. Direct services to a few school systems, other services to teachers anywhere. SIG Evaluation of micro software now meeting and formulating criteria. Transforms programs from large systems to tape cassettes for TRS-80, Apple, PET. Westwood, Massachusetts.

H3 HUG Northshore. Heathkit Users Group.

LE Lesley College Educational Users Group. Library of programs, books. Special meetings and conferences run throughout the school year. Cambridge, Massachusetts.

L2 Long Island Computer Association. SIG, TRS-80, KIM, Software exchange, etc. Plainview, New York.

M9 Microcomputer Users Group. Business Users Group. New York, New York.

N5 New England Computer Society. SIG PET Users. Meetings, bulletin. Bedford, Massachusetts.

*these initials are keyed in the listings in the Appendix.

Table 1 (continued)

N6 New England Apple Tree. Many teachers with school or personal Apple II. Lexington, Massachusetts.

R2 Rhode Island Computer Hobbyists. Bristol, Rhode Island.

R4 Rochester Area Microcomputer Society. RAMS SIG:Apple, TRS-80, S-100. Rochester, New York.

R5 Rockland Country Compucolor Users Group. Spring Valley, New York.

T1 TERC (Technical Education Research Centers). Many services to teachers without charge. Newsletter Hands On! distributed to 10,000 educators. Manufactures inexpensive computer items, including software on cassette and disk. Cambridge, Massachusetts.

T8 TRS-80 Software Exchange. Milford, NH.

TB TRS-80 Business Club of Arlington. Arlington, Massachusetts.

software sharing programs as part of this commitment to microcomputers. Examples of these are the BOCES in New York, the Regional Education Center in Hanover, New Hampshire, and the Minnesota Educational Computing Consortium. For more information on these agencies, see Part D of this report.

There are two major impediments to widespread sharing of teacher-generated software: documentation and distribution. By documentation, we refer to the fact that most teacher-generated software has been developed by one person for his or her classroom. Because of the way it was developed, there was no need to write down the educational objectives,operating principles, or any other details about the hardware, educational context, or design of the curriculum material. However, without such documentation, the material is often useless to other teachers. Similarly, the teacher/author of a program does not need information about the educational value of the program that is gathered through informal classroom observation. However, this evaluative information is absolutely essential to other users. How else can one choose between many different programs that purport to serve the same educational objectives? Most teachers have neither the incentive nor the means to distribute their programs beyond their immediate range of acquaintances and professional contacts. There is little incentive for businesses to invest time and money in disseminating the material which is not copyrighted. As a result, even adequately documented software is not being distributed as widely as it should be.

A number of organizations and projects have been established to begin to overcome these barriers to the sharing of educational programs. The Northwest Regional Educational Laboratory in Portland, Oregon, has launched a program called MicroSIFT, under the direction of Judith Edwards and Donald Holznagel, to evaluate and disseminate educational software, with particular emphasis on software generated by funded, nonprofit educational projects.

The Apple Education Foundation, a nonprofit group funded by Apple Computers, is undertaking a similar evaluation effort for 160 educational programs in eight subject areas that they have identified, to be printed in July 1980. Most of their programs will be commercially available, thus solving a dissemination problem.

Nationally disseminated software

The next section of this report details the educational software that is distributed nationally and is available from businesses, nonprofits, and other groups.

AVAILABLE INSTRUCTIONAL SOFTWARE

B. Produce a resource listing of instructional courseware, according to computer type, program language, grade level, objectives of instructional program, location, cost, and how to obtain.

A large number of commercial vendors and nonprofit agencies distribute educational software for microcomputers. Comprehensive lists of the available software, as well as the sources of this software, are included in the Appendix to this report. This listing represents the state of the art to the best of our knowledge in May 1980, but because the field is rapidly changing, it should be considered as in process rather than the final word. We are maintaining both the listing of programs and the listing of sources of those programs on electronic data bases so that they can be easily updated and refined as more information becomes available. The updated files are being maintained in machine-readable form on a diskette suitable for a Compucolor II and on a large data base that can be accessed through remote terminals.

Criteria

Not all educational software is listed in the bibliography. We have selected according to the following criteria:

Educational value. Of the many software suppliers, we selected programs from only those known to generate useful educational programs. If a supplier had all kinds of programs, we selected only those we felt had educational value. Arcade games were excluded, but games that had some learning or developmental value were included.

Supplier reputation. There are reports of technical and delivery problems from some suppliers. For this reason, suppliers unknown to us and unwilling to supply sample material were excluded.

Hardware. The primary emphasis of the listing is on programs that run on the popular microcomputers. Only unusually valuable or unique programs for other microcomputers were listed.

Availability. Only software currently (May 1980) available is listed. Some suppliers are advertising software that is not available; it is not listed. For instance, Bell & Howell lists an extensive series of programs for its Apple II which it says will be ready September 1980.

Atari programs. Atari Company has a large series of programs that run on its machines. These were excluded because there are currently few of these in schools and the quality of the inital programs is unacceptable.

General Observations

There are several interesting conclusions from this exhaustive survey of educational software. First of all, there are no giants; there is nothing comparable to IBM in educational software. Typically each source has a dozen or so programs; many have only a few of educational interest. This situation is likely to change in the next year. There is one dealer in educational software (QUEUE Consulting Services) which has the potential of offering the convenience of a single source as well as the guarantee that at least the program you order will arrive and execute on your computer. On the other hand, this distributor is undergoing a dispute between its two principals which will result in two rival organizations and may cripple both.

A second observation is that many programs are based on the same material or the same ideas. To the extent possible, we have listed similar variants in the same entry in the data base. However, it is beyond our financial resources to purchase all the software and we suspect from the description and titles that there may be other duplications. The conclusion is, there are

really many fewer good ideas in educational computing than there are available programs.

Unfortunately, normative information about these programs is largely lacking. At this time there are a few reviews, but in most cases, the primary way a teacher can evaluate this material is to get hold of a copy of the program, presumably by purchasing it. Because of the ease with which programs can be copied, vendors are extremely touchy about releasing free copies or copies on consignment for inspection. There is a clear need for reputable organizations to collect and evaluate educational software, and make it available for teacher inspection. We are attempting to do this through our Computer Resource Center but have found it extremely difficult to gain the confidence and cooperation of the suppliers of educational software. Contacts with over 50 different vendors yielded only the software listed in Table 2. We are deeply indebted to those vendors and appreciate their good will.

Spaces have been left in the listings for evaluation information to be added as it becomes available.

TABLE 2

LISTING OF VENDORS CONTRIBUTING

EDUCATIONAL SOFTWARE

Hayden Book Company	H1*
Instant Software	I1
Milliken	M5
Muse	M8
Microphys	MP
Programma	P5
Programs for Learning	P6

*These initials are keyed in the listings in the Appendix.

On the availability of software

It is popular these days to pronounce that there is essentially no good educational software available for microcomputers. What is available is summarily dismissed as being of low quality, games or rote drill and practice. It is certainly true that we are looking at a field now only in its infancy that promises a much more comprehensive variety of software and many more imaginative educational uses of computers. Nevertheless, one cannot fairly dismiss all of the hundreds of programs listed in the Appendix to this report, the exemplary programs described in the previous section, or the various implementations described in the later sections of this report.

We sometimes wonder if the people complaining about the lack of availability of microcomputer software have misconceptions about how microcomputers should be and can be used in the classroom. The most popular misconception is that the computer can take over the role of teacher, that a student can be plugged into a microcomputer. It is our view that except for very short instructional sequences prescribed by a teacher, large-scale computer-controlled instruction is neither feasible nor desirable. Certainly, good material of the sort is not currently available for microcomputers; we view the lack of this type of software as a natural and continuing phenomenon.

A more sophisticated complaint about the lack of availability of software stems from the unusual nature of much of the available software. The fact is that the power and flexibility of a microcomputer, combined with its low cost, open new educational opportunities, many of which do not happen to fit neatly into the current matrix of disciplines and educational levels. Thus, from the perspective of a teacher embedded in this matrix, much of the material seems to be irrelevant. The challenge that the microcomputer in general (and the software, in particular) creates for education is to find

ways in which microcomputer power can be used. The possibility of using a computer to gather and reduce large amounts of data (Cooling Curve), to simulate a complex system (Three Mile Island), and to learn about the process of solving mathematical problems (Buggy) opens up possibilities that we never previously considered because they were thought to be outside the range of activities that were possible in a school. These examples are only the beginning; as microcomputers gain in power, they will be capable of even more flexible and imaginative educational uses that the educational community will have to find ways of exploiting.

Keeping up

As with all printed material in this vast moving field, this report will be out-of-date the day it is published. Educators wishing to keep abreast of the most recent developments in these areas should read the related journals, stay in touch with the hardware manufacturers, as well as the software vendors, follow the developments of the projects and agencies that are serving these needs, and where possible, attend one of the major national conferences devoted to educational computing, such as the National Educational Computing Conference or the annual meetings of the Association for the Development of Computer-based Instructional Systems.

While there are many journals devoted to microcomputers, we have selected nine listed in Table 3 as being particularly relevant to educators. Robert Purser's Software Directory is the single most comprehensive listing of microcomputer software. Each issue includes all available software for the TRS-80, Apple, PET, and Atari, including, but not limited to, educational software. In addition, Purser selects numerous programs each issue for an extensive description and rather uncritical evaluation. The Computing Teacher

TABLE 3

JOURNALS AND PERIODICALS

RELATED TO INSTRUCTIONAL SOFTWARE

The Computing Teacher
Computing Center
Eastern Oregon State College
La Grande, OR 97850

Dr. Dobb's Journal of Computer
Calisthenics and Orthodontia
Box E
Menlo Park, CA 94025

Hands On!
TERC Services
8 Eliot Street
Cambridge, MA 02138

Personal Computing
1050 Commonwealth Avenue
Boston, MA 02215

Pipeline/CONDUIT
P.O. Box 388
Iowa City, IA 52244

QUEUE
5 Chapel Hill Drive
Fairfield, CT 06432

Recreational Computing
1263 El Camino Real
Box 3
Menlo Park, CA 94025

SIGCUE Bulletin
Association for Computing Machinery
Box 12105 Church Street Station
New York, NY 10249

Purser's Software Directory
c/o Robert E. Purser
P.O. Box 466
El Dorado, CA 95623

has grown from a mimeographed sheet entitled the Oregon Computing Teacher, to fill a national need as the only journal of its kind. QUEUE started life as a free catalog of educational software, but it looks as if, with the next edition, the company will try to make money off the publication, as well as off the software they sell. SIGCUE Bulletin is a publication of the Association for Computing Machinery's Special Interest Group in Computer Uses in Education. This group has a subcommittee concerned with elementary and secondary school uses of computers which is further divided into 29 task forces, which report their recommendations and findings in the Bulletin. Hands On! is our free newsletter that tells about TERC activities related to computers in education. Pipeline is the journal produced by CONDUIT. It contains a description of all of their material, as well as journal articles and news. Recreational Computing, Personal Computing, and Dr. Dobb's Journal are three commercial journals which are software-oriented with an interest in educational orientation. In all three cases, the advertisements may be as useful as the articles in terms of keeping abreast of commercially available software.

Each of the major manufacturers of microcomputers has made a major commitment to educational applications and has staff who are primarily concerned with these issues. Major manufacturers, and their addresses, are listed in the Appendix.

Future developments

Extensive educational research and development efforts have yielded instructional software of proven educational value which is not yet available on microcomputers. This situation is certain to change in the near future.

One example of the software that can be expected comes from Project LOGO

at Massachusetts Institute of Technology. This project embodies an approach to the educational use of computers that emphasizes programming in a special language called LOGO and utilizes techniques like Turtle Graphics to make programming accessible to very young children. This approach has been thoroughly school-tested but is unavailable on microcomputers. M.I.T. is now adapting LOGO to operate on a modified Texas Instruments microcomputer.

A version of Turtle Graphics is available for S-100/CPM microcomputers as a graphics-enhanced version of BASIC called GRASIC. The Apple PASCAL language has Turtle Graphics, but this will not execute in the immediate mode and so it lacks the interactiveness that LOGO has.

Many microcomputer manufacturers, book publishers, and distributors have major software-generation efforts under way. For instance, Atari is working with Science Research Associates to produce a large body of software.

SCHOOL APPLICATIONS

C. Document examples of current school applications and roles of microprocessors within the seven participating states

Microcomputers are used in every conceivable way in schools within the Northeast region. Considering that the first microcomputers only became available to schools a few years ago, it is remarkable how quickly they have been taken up and integrated into a range of school uses. They continue to proliferate at a startling rate, despite budget cutbacks. A recent survey carried out in Connecticut, for example, showed only 17 high schools without microcomputers. Whether they were stimulated by the questionnaire or had planned to buy machines anyhow, all but four high schools in the state now report that they will have microcomputers by September.

Across the region, "going microcomputer" means very different things. In the poorer states, a system may be lucky to have one machine, shared among many classes or even several schools. A rich suburb may have several in each school. Micros are bought with school funds, acquired through Title IV-B or IV-C grants or other state funded mini-grants, brought in by parents or students, built or bought by teachers with their own funds, installed by hardware dealers, donated by local businesses or industries, leased or loaned by regional centers.

A single teacher - most often a math teacher - may go to a meeting, workshop, or presentation and get hooked--that's how most schools report getting started. This accounts for the wide diversity of machine makes found in schools where there are no state or regional groups to aid with group purchasing. The traces tell the tale. In Maine, Vermont, and New Hampshire, the Radio Shack TRS-80 got an early start. It was the cheapest of the machines, widely promoted and widely available, and it has a lot of software, not all of it reported good by teachers. When Commodore PET offered a three-for-two bargain, schools near PET dealers bought PETs while the bargain held. When

Minnesota, the first and largest statewide consortium, went Apple a year ago, after a decade of mainframe time-sharing, well-to-do suburbs bought Apple IIs. (Now Bell & Howell has come out with its own educational package involving Apple machines with gray plastic cases; these are known in schools as "black Apples"or "Darth Vader Apples.")

The scene looks chaotic. As we reported earlier, each microcomputer uses its own version of BASIC. Software sold for one machine cannot simply be used on another manufacturer's machine, though the differences may be slight. For programs to be shared, some intermediary system has to be in place or else teachers have to learn to do extensive programming or limit themselves to what's available for their own machines. This may prove even more of a problem as the newer versions of existing microcomputers come out: Apple III and IV are in the works with very different configurations (and higher costs and capabilities), as are TRS-80 Level IIIs. Fortunately, no investment in microcomputers is wasted. What is supplanted by a newer machine with more challenge for practiced students moves down to the primary grades where it is totally engaging to beginners.

As we will report in detail below, no state in the Northeast has an official policy regarding school microcomputer acquisition, though several have guidelines for specific funds to be spent on computers. No state has a single person who sets policy for microcomputers, though in each state we were able to discuss what is going on with someone who has oversight of one or more computer applications in that state. It was often the case, however, that the initiative for using microcomputers came from the grass roots--a teacher, subject-matter specialist, or department head, or occasionally a principal, and the state department of education had little information about what was going on. In some sense, microcomputers constitute a genuine popular revolution, unlike most educational innovations, which are funded and introduced from above. One reason for this is, of course, that manufacturers -- who began

aiming at the home hobbyist market--soon realized the possibilities for encroaching on the turf of the textbook publishers. Now the publishers are beginning to revise their texts to include microcomputer use!*

Whatever the machine of choice, the same problems exist for most schools:

1. How to train teachers so they can be comfortable with micros and stay ahead of their students. (Students take to the machines immediately and move very fast. In many systems, students are handling programming needs.)
2. How to learn about, select, exchange, or write software. This is particularly acute in communities that are far apart and far from centers.
3. How to find the money to acquire more machines. It is hard to give each teacher enough time on the machine when there is one to a system or school, or even grade. It is impossible to give each student anything like enough hands-on time with one machine in a classroom. In the same vein, schools would like money to extend the capability of an existing microcomputer--to add memory, disks (or devices to speed up cassette loading), graphics, or a printer, for example, to add word-processing capability to data-processing capability in business courses.

In this last connection, it should be noted that many high schools in the region have had their own mainframe computers for several years, often with terminals in administrative or town business offices, teaching terminals in school business and math departments, and a terminal in the guidance offices. These have been used by business majors, advanced students seeking enrichment, lagging students needing remediation, and math students at all levels. In adding microcomputers to their existing terminals, schools are acquiring

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*D.C. Heath, for example, is redesigning an elementary math series by increments and, if field tests are successful, expects to extend the revision to other grades and other subjects.

low-cost graphics and additional stations, as well as portable set-ups. (Many micros go home at night with teachers or students.) Some schools needing music enrichment buy one of the microcomputers that offers music instruction (Apple or Atari). Most interesting is the comment of one high school's staff that they were replacing their terminals with micros because the cost is so much lower (see below).

Funding for microcomputer acquisition comes from a range of sources as indicated earlier. This year, in particular, schools across the region applied for Title IV-B and IV-C grants from their states. Title IV state coordinators were flooded with such applications, in large part because Tandy, which makes TRS-80s, sent out a flyer to each school, telling how to get funds for microcomputers. While there were some factual errors in the flyers, the basic information fostered awareness in school personnel, and the rush was on. Alas, hardly were the grants decided when President Carter ordered drastic budget cuts and Title IV funds were cut, thus stopping the tide, at least for awhile. At this writing, Congress seems to be recommending restoration of revenue sharing. What effect this will have on Title IV appropriations is unknown. Nonetheless, schools continue to get equipment by whatever means they can find. Naturally there is great disparity between wealthy suburbs and isolated, poor rural communities, particularly in Maine, Vermont, and New Hampshire. Educators who are most eager to increase their use of microcomputers complain of their states being too poor. Rhode Island is poor, too, but micros have not found their way into rural districts as much. New York is rich, by contrast, as is much of Connecticut, and Massachusetts is the heart of the computer industry in the Northeast and has active programs in many school districts.

Here is a rough summary of what we have learned about microcomputer use in each of the seven states, reported alphabetically.

Connecticut

We were most fortunate that one of our staff gave a workshop for educators, both precollege and postsecondary, at Asnuntuck Community College in Enfield, Connecticut, early in the course of our study. There he met Steven Leinwand, Math Consultant in the state department of education, who has recently completed a survey carried out in the fall of 1979 of computer use in Connecticut schools. Leinwand's report is remarkably comprehensive and useful to examine, though as he said recently, microcomputer use is increasing so fast that the figures are already obsolete. It is included in the Appendix. We found it an excellent source of data.

Connecticut is a well-to-do state, and its proximity to New York and Massachusetts makes travel to out-of-state workshops and meetings possible. School personnel were well informed and linked into microcomputer user networks. Hardware distributors have offices and stores in the state, though they are not always helpful with information about educational software. Nonetheless, teachers are knowledgeable and enthusiastic about micros. The wealthier towns have a terminal or micro in each elementary school. Because of Title IV-C cutbacks this year, teachers are going out to "beg, borrow, or steal from industry" to get more equipment. (In one town to which Union Carbide was moving, teachers arm-twisted the company to contribute to their funds for acquiring microcomputers--pro bono publico!)

Two different but equally strong models of microcomputer use are described below. In addition, we should point out that in Connecticut, as elsewhere in New England, private schools have often moved into microcomputers very fast. This summer, for example, the Taft School is hosting a three-week training workshop for personnel from public, as well as private schools. Ed North is the coordinator. TERC's Rick Kane will be on the faculty.

A newspaper report on a typical microcomputer seminar is shown below.

Seminar will discuss use of micro-computers

The Bridgeport Education Department, in conjunction with the Applied Data Services of New Jersey, will sponsor a day-long seminar Wednesday on the use of micro-computers in education in the Holiday Inn at 9 a.m.

Speakers include Bridgeport Superintendent of Schools Geraldine Johnson, Mrs. Gladys Hill, principal of park City Magnet North Campus, which is currently using a micro-computers in its math program; Leroy Dupee, the city's mathematics supervisor; Dr. Ludwig Braun, professor of engineering at the State University of Stony Brook, Long Island; and Dr. Syliva Charp, director of Instructional Systems of the Philadelphia Public School System, and Wayne Verderber, president of Applied Data Services.

Materials for the seminar have been donated by the Connecticut National Bank, Mechanics and Farmers Savings Bank, People's Savings Bank. Presentations will be provided by Computerland of Fairfield; Computer Works of Westport and Time Share Corporation.

Coordinators include: Dupee, Verderber, Frank Whittaker, the city's assistant mathematics supervisor; Alexander Norwood, the city's acting supervisor of elementary education, Gwendolyn Armstrong, a Park City Magnet resource teacher, and Eleanor Posey, a Park City Magnet computer specialist.

Andrew Ward High School, Fairfield. Robert Genualdi is Principal and a staunch supporter of microcomputers in his school. The school has a reading lab with 4 Apples. They've developed their own software based on their own texts at three levels of difficulty, in three areas:

1. Reading for the main idea (in social studies, English, and science).
2. Context clues.
3. Note taking.

In addition, they are offering computer literacy for all general math students and giving them hands-on experience. There is a computer programming minicourse in all senior math courses. They also offer a semester course in computer

programming. Thus they are able to reach students at all academic levels, and reinforce study skills. The funding for this effort came in part from Title IV-C. It has the distinction of being interdisciplinary and using several modes of computer-assisted instruction, as well as of using original programs. Andrew Ward also has a Wang computer with a printer and CRT. Its guidance department has a time-shared terminal, as well.

Manchester High School, Manchester. Blaine Miller is Director of Educational Data Processing. This school has an "evolving" model. Miller got into micros at a conference last October in New York State. He had been sharing a mainframe previously with the town government, teaching students FORTRAN. Now he has 3 micros. He is drawing up a plan for renovating the 25-year-old high school building, and he is planning a computer lab with 20 micros in a math setting, 6 in a learning center for other curriculum areas. He plans to spend about $45,000. The town has a K-12 study committee, three-fourths of whom don't know what microcomputers are in education. Miller is spending 10 hours a week giving them a short course in BASIC.

Blaine Miller sees isolation as a big problem. People have no way to get help from one another or workshop givers. He has found dealer instruction to be all promises, little reality. He goes to every meeting he can get to, reads and subscribes to software journals and user magazines. He has put together 30 programs apart from those that come with commercial subscriptions (CLOAD, CURSOR). He believes that little is gained by having "one PET floating through an elementary school." He believes in the "cluster" concept--four or five micros with a printer to constitute a critical mass for teaching.

Miller splits his time between the high school and the data processing center. His micros are used for word processing, spelling, math drill, and the like in elementary school. In junior high, they are used for math literacy. In high school he is working with teachers before they"let the kids loose on the machines,"in such subjects as science, chemistry, and math. He has

programs for science that will create a bar graph. He is very enthusiastic but wants help to get beyond his present level of knowledge. Like many teachers we talked to, Blaine Miller is largely self-taught in the field of microcomputers. He has learned enough and is motivated enough to pull a whole school system along with him.

Maine

Maine has a very enthusiastic Title 4 Dissemination Director, Dick Riley, who is keen on microcomputers. This winter, he added three questions about micros to an Instructional TV questionnaire he was sending to all schools. Out of the 390 schools that responded, 40 have micros. More than half have TRS-80s. Only a few have more than one machine (e.g., Rumford High School has six PETs, Berwick Academy has three Level II TRS-80s, Bath Junior High School has two TRS-80s). The report is in the Appendix.

Maine has little state money to share and depends on Title IV money to support equipment purchase. An ongoing Title IV project uses TRS-80s as Teletypes and gets programs sent through to micros by airwaves. This project is "Learning Through Amateur Radio Satellite," and its director is Steve Gurin at Richmond Junior/Senior High School.

Dick Riley has been converting PDP programs for use on micros. He sent for the CONDUIT programs and has programmed two himself for displays, since the PDPs are for printout. (He says it was "a helluva job"!)

Some interesting program models are described below.

Mount Desert High School. Howard Johnson, Math/Computer Director. Johnson proposed an ingenious network project this year for sharing software. It was awarded the Title IV grant and would have begun solving a key problem for Maine--isolation of communities--but Title IV funds were cut from the Presidential budget. He is trying to get people together to put pressure on legislators to restore the cuts. The networking project proposed to link

schools in sharing a cohesive curriculum throughout the state. Johnson found that 34 out of 100 schools have TRS-80s, so he would share software primarily for these machines. He also allocated money to pay students to type in programs.

Johnson got started ten or twelve years ago teaching students to use teletypes. As a result, he believes that color graphics are not necessary and he would rather have students learn assembler language than "play games." He could have graphics capability through a plug-in. He has students try independent study projects.

He has had micros for five years: two Southwest Tech computers he has built himself from early kits and added onto, using his own money and borrowing the rest. They have 32K each, a 6809 chip, and a 40 column printer, with a listing of programs. Both machines are in the high school where students use them in a full-semester course. (He uses Kemeny and Kurtz --a college BASIC text; it was recommended by all 30 high schools he surveyed.) About half the instruction relates to math. Next year he wants to do biology simulation games, physics, and chemistry--for which he knows a good lab program. He likes "Middle Ages," a social studies simulation dealing with economic and social trade-offs.

One plan Johnson had for his Title IV project was to use two OSI machines with donated televisions and set them up in a center for students to use. He will try to do this anyway. He also plans to use the school's video monitors and hook them up so that students can see them all over the classroom as computer displays. He is very inventive and knowledgeable about hardware--a "shoestrings-and-sealing-wax" teacher who makes things possible for his students. For example, he is not fazed by slow cassette loading and has assembled a 40-second per program loader. (He also comments that a third of TRS-80 programs don't load properly, as reported by teachers across the state.)

South Portland High School. Ann Waterhouse, Computer Specialist.

Ann Waterhouse is known across Maine as a teacher trainer and knowledgeable resource for computer education. She began with time-sharing ten years ago and had her students doing professional work. (We were told that when the University of Maine/Orono installed its new computer system, Waterhouse's students were hired to get it going and show staff what to do.)

South Portland just acquired two Apple IIs for problem solving and scientific programming instruction. This is part of a two-year plan, to be implemented with Title IV funds if they exist, to get micros into every school. In the high school, Ann Waterhouse uses micros to complement the PDP-11/70 with graphics and music instruction. (The music director wants an Apple II or Atari because they offer a music program.) In the 8 or 9 elementary schools, Waterhouse plans a micro for all fifth-sixth grade use, teaching computer literacy and remedial skills and training teachers. In the high school, computers are used for math and business instruction and guidance.

Ann Waterhouse helps teachers in other schools get started with computers. She offers summer training courses that fill a great need. Her plan is a practical model to add four or five micros a year until all students have access to a machine.

Massachusetts

Because of the presence of high technology industries in Massachusetts, the state has active involvement in microcomputer use, especially in the "128 towns." Vocational-technical high schools are desperately trying to catch up to the need for computer technicians and programmers by offering a range of computer courses, but hundreds of jobs need filling. The presence of universities and technical colleges adds parental pressure to offer microcomputer instruction in all grades. In some communities, parents contribute hardware or students have their own. Often parents are volunteer

teachers in the schools.

The range of school programs goes from the most innovative to the most fundamental. Some schools are reported to have gone computer in a big way. These include Assabet, Mt. Wachusett Regional, Nashoba Valley Regional Voc-Tech, Framingham North, Newton, Lexington, and so on. Chelmsford is using microcomputers in G.E.D. work with correctional institution inmates.

Jack Reynolds, Title IV coordinator, reports that Title IV has been a source of funds for micro acquisition, and this year's cutbacks have dealt a blow to systems planning to buy computer equipment. One model that has been successful in Massachusetts is a collaborative one where systems or teachers gather together for hardware purchase or sharing and software exchange. A new teacher center in the city of Boston will have a substantial microcomputer capability; the director is Richard Koch. A group of teachers conducted their own survey of needs in the Eastern Massachusetts region; their report is in the Appendix. Several projects are described below.

Uxbridge, Project CAPTURE. Joseph Mahoney, Director. This is a Title IV project, grades 5-12. The original plan was to buy 8 TRS-80s; now the staff are interviewing other vendors as well, particularly Apple II. They began with 70 students identified as gifted and talented, and set out to teach them programming, largely in math. They developed a two-week unit on research and problem solving as an extracurricular activity. The students develop appropriate programs for teachers and also help middle-school students.

Oxford High School. Paul Chase, John McKeon, teachers. Oxford uses a TRS-80 with memory, disk, and printer to teach programming in BASIC, under the math program. In science, they are using a KIM-1 with a TERC lab interface to record real-time experiments. They also have several terminals to Holy Cross College's mainframe in Worcester.

An engaging project is a solar greenhouse, designed to show how you can

both grow plants and heat your house with solar energy. Here a Rockwell AIM is used to monitor and control temperature, humidity, and light. The project is federally funded and uses students who have had academic difficulties to operate the computer and repair and maintain it. They are trying out different control strategies to study efficiency.

Lincoln School, Brookline. Dan Watt, Project Coordinator. This is an unusual project with NSF and Brookline funding, using LOGO, a language developed at M.I.T. and elsewhere expressly for children to learn programming. The project had a two-year pilot with two General Turtle computer set-ups. The computers remain in each fourth to eighth grade classroom for 8 to 12 weeks. Students can use the micros individually before or after school, or can work in pairs They are scheduled during class times and have a whole-class session once a week. Teachers have been trained in the school to handle this. A townwide committee is looking into what the town should be doing in this area.

Lexington Schools. Beth Lowd, Computer Specialist. Lexington, in the heart of 128 country, has had large time-share computers for a long time and still uses them heavily for management and administration. They began adding microcomputers under teacher and parent pressure and draw on volunteer parent-teachers. The parents want computer literacy for each student.

There are about four micros--38 PETs and 2 Apples--in each of the 8 elementary and 3 junior high schools; the system owns about 40 total. These were purchased with school money, Title IV-B funds, and PTA donations, as well as other external money. Three micros are in the computer room one in a town-wide school administrative area, and one in the Curriculum Resource Center.

Micros are used in English instruction, special education, reading. In the junior highs, programming, math, and computer literacy are taught. The computers travel on carts between classrooms. They stay in an elementary

classroom for two weeks at a time. Sometimes 2 or 3 classrooms share a computer on a sign-up basis. The machines go home weekends with teachers or parent programmers. Beth Lowd supports teachers and helps them to use the machines in their courses.

Project LOCAL. Robert Haven, Director. Bob Haven began in 1967 providing time-sharing to a group of seven suburban towns. He offered services, workshops, teacher training, and software and hardware purchase and sharing. He has moved into microcomputers and continues to be a seminal force in Massachusetts, conducting software reviews and getting groups together to serve the needs of their schools and classes. LOCAL is supported by town funds from each school district. It is a good model of voluntary collaboration for cost-effectiveness and service.

New Hampshire

Like other states, New Hampshire has a heavy emphasis on computers in business education. Donald Peterson, who directs this area for the state, believes that the future is in word processing, rather than data processing, and he has encouraged schools to buy $10,000 systems that will do both. He sends people to Computer City. He would rather have them buy a TRS-80 with word-processor add-ons and have them use it for business instruction and other school uses.

Peterson feels that computer instruction is critical for the state's economy. He cites a teacher at Portsmouth, Martha LeFevre, who has placed 135 students over time at the Portsmouth Navy Yard. Somersworth, White Mountain Regional, Littleton, and Milford are other interesting sites. A CETA program in Woodsworth will train people in 16 weeks to work in a local industry. The Cheshire Vocational Center in Keene is also training people.

Bruce Ryan, a key figure in microcomputing, reports on an interesting regional model, described below, which is probably the way most states with

little funding will eventually have to go.

Hanover Regional Center for Educational Training. Del Goodman, Joe Longo, Computer Specialists. This center has two programs that provide services to 11 superintendencies in New Hampshire and Vermont. It also puts out a newsletter that goes to a much wider audience. They are affiliated with KIEWIT at Dartmouth College, the large time-sharing program with terminals in many schools.

The Center sponsors a Computing Club. It has an open house with commercial vendors and a student microcomputer fair. The Computer Club meets monthly with students coming from all over the district.

The other service it offers is cooperative purchasing. This year, instructional microcomputers are the focus. They have prepared a catalog of micros and peripherals, and they get bids on quantity, saving money for members. They advise TRS-80s (90% of membership agrees) to simplify software sharing and maintenance. The exceptions are communities that already have other machines or color graphics, for example. The district has PETs, TIs, and Ohio Scientific microcomputers, as well as TRS-80s. They recommend Level IIs because "it takes a month for the kids to go past Level I."

In seventh grade, students are doing a compiler for a new language. This is evidence of the success of the learning that goes on through the Hanover approach.

New York

New York offers a very different picture from the rest of the states in the Northeast region. First, it is very much more advanced in computer education. Second, it is very rich, compared to Northern New England. Third, it has a built-in delivery system in its regional BOCES, centers serving 20 or more districts with all kinds of supports. Bob Trombley, who heads EPSIS, reports that the state has appropriated $18,000,000 to develop software in

three areas: CAI, instructional support services, and administrative services. At the same time, the discrepancy between rich and poor communities continues. The rich systems, like Nassau County, are "buying all kinds of things," largely TRS-80s and Apples. The rural populations are left in the lurch. People are worried about investing in soon-to-be-obsolete equipment and seek guidance. Educational software is a need.

The special feature of New York's educational system is the BOCES. BOCES activity is coordinated through the office of Conrad Mettergreen, and the BOCES are affiliated in a state network known as the New York State School Computer Service System (NYSSCSS). Connie said something very interesting about the information gap between the SEA and LEAs in the matter of microcomputer purchasing. There is a state law requiring clearance by the state for all computer purchases over $10,000. Therefore, communities are funding their microcomputers from all kinds of pockets to avoid having to go through the state, which might deduct the cost from state aid. The other effect of this requirement is to encourage schools to do cooperative purchasing and implementation through their BOCES. (Two BOCES programs are described below.) There is a state task force headed by Norman Kurland, which is considering what hardware purchasing policies ought to be. Again, Title IV, coordinated by Michael Radlich, has been a source of funds for microcomputer acquisition.

Westchester BOCES #1, Portchester. Raymond Sherrier, Computer Specialist. This BOCES center has a computer laboratory to which teachers come, K-12, for training, to share or develop software, or to have software developed. They also can use the machines for their own development purposes. The center suggests PETs, TRS-80s, and Apples. They also own a Compucolor. The PET three-for-two bargain attracted some districts. The center has 30 machines - 12 in labs, the rest in classrooms - which they loan to schools and take care of under a contract (see Eastchester below).

Ray Sherrier serves Rockland, Westchester, and Putnam Counties with his

Regional Computer Center--60 schools and 180,000 students (of whom 120,000 are in public schools).

Eastchester High School. Tim Gallagher, Raymond Pace, Computer Specialists. Tim Gallagher has set up a computer center in a double classroom in an adjunct building. One half is the micro lab, the other half offers a business milieu with terminals, Xerox, and other office machinery. To give the place a reality, he works there himself some of the time. The center has several PETs, plus printers and floppy disks. Students learn programming and math. Teachers share software.

Ray Pace offers two half-year programming courses, advanced math, remedial programs for children who need them.

They both agree that micros are cheaper than time-sharing and that is one of their big attractions. Terminals were costing them $12,000 to $15,000 a year, with $1500 to $1700 per machine just for line charges --thrown away, they feel. Now they maintain one tie for accounting and spend the money for micros.

The lease system is very beneficial to the schools. During the first year, they pay the cost of the machine. The second and third years, they pay $300 a year. This gives them service, overnight replacement if a machine needs repair, and updating. They have peripherals, as well. The critical point is that the lease costs are 65% "aidable," while purchases are not reimbursable. The school has no commitment to a particular set-up and can change its machines or update them.

Another system, Tuckahoe (Ron Gindick, Computer Specialist), has integrated its on-line services with micros. They supply their own software and carry out 50 payrolls with a $2.8 million budget.

Monroe #2 BOCES, Rochester. Daryl Van Alstyne, Coordinator, Regional Instructional Computing. Monroe serves 22 districts in the Rochester area.

They have been using computers for five years and have spent two of them training teachers in the BOCES and on site. They are part of an NSF grant to SUNY/Brockport to train a corps of teachers on microcomputers. This summer, they will have a curriculum development program with teachers working in math and (one or two) in science. They encourage training before hardware. They will have 100 micros this year, bought with Title IV-B grants, parent donations, school funds. Xerox and Kodak employee parents serve as volunteers. They prefer to own their machines for development, and share software.

New York has many other interesting models. One that has been reported to us is in Dix Hills, Long Island. It is a magnet school program with one classroom devoted entirely to microcomputers. Gifted children come in the morning to work at the computers. Afternoons, teachers learn to program. They have 200 programs. The director is Jerry Burke.

Karen Billings runs a Microcomputer Resource Center at Columbia Teachers College.

Rhode Island

Donald Gardner, Director of Field Services, reports little computer activity in his state. South Kingstown is interested in getting into the field but is held back for lack of money. One site is briefly described below.

Charlestown, RI, Schools. Barbara Weldon, Principal, elementary school. Dr. Weldon is pushing microcomputers. She began with a TRS-80, using it with gifted and talented students in the sixth grade. She has gone on to wider uses, and she is now using it with younger children in special education programs.

Vermont

Bob Kenney is math consultant for the SEA in Vermont. He is beginning a list of school use of computers. His first cut is going on this spring and

should be revised this summer. He feels that there is much promise in elementary school use of micros, since most high schools are using mainframes in rather conventional ways.

People are interested in swapping programs. Vermont is heavily rural, so isolation is a problem, and sending cassettes by mail is effective. Most schools with micros have TRS-80s, Apple IIs, or Sorcerers. Schools with interesting programs are described below.

Mary Hogan School, Middlebury. James Callahan, Principal and math teacher. Jim Callahan got into microcomputers at a meeting in Saxon's River 2 1/2 years ago, using Max Ogilvy's PET. At present he uses his PET with sixth grade advanced students and all fifth graders. He has 30 children writing their own programs, and he barely keeps ahead of them. There is a 2 1/2-month program for gifted and talented supported by a minigrant. He has had a consultant come in to give a short course on BASIC but feels he needs more help. This summer he plans to take a course at St. Michael's College. His biggest problem is isolation, He can't get the advertised help from vendors since it is 25 miles to the Computer Mart in Essex Junction. He has 600 children to be responsible for every day and can't take time off. His case is more the norm than the exception in Vermont.

Barretown Elementary School. Jean Stefanik, Curriculum Director. Jean Stefanik began with a Title IV-C gifted-and-talented project in math, using calculators and other computers. Now she is a Resource Agent for the state of Vermont, and is paid to be a consultant to other schools. Her initial project had 10 third and fourth graders. Now she has the same children in fifth and sixth grades plus more children. Her computer resource center serves 1100 students K-8 in a district school and her biggest problem is enough equipment.

Stefanik has trained a great many teachers both in her course on Basic Computer Literacy for Educators and in teaching programming. The critical

factor for her in effectiveness is enough hands-on time. She would trade sophistication to get more micros for the same money. She has a TRS-80 Level I and a TRS-80 Level II. She feels that for most elementary school purposes, Level I is adequate--for both students and teachers.

She started a fifth grade Computer Club after school, thinking that only a few children would sign up since parents have to provide after-school transportation if the children stay late . To her amazement, she had 80 signed permission slips the next school day. Everybody wants a chance on the computers.

Summary

The above sampling can give only a small taste of the range of models, programs, schools, and dedicated teachers working with microcomputers in the seven Northeast states. What is consistent is the excitement this new technology has created in so few years. This is a grass-roots revolution that spreads despite budget cuts and time constraints. Students and teachers are motivated to overcome all obstacles in poor communities and rich ones. The same needs are expressed: software, communication, teacher training, money for hardware. The same enthusiasm persists. Only the solutions are individual across the region.

SCHOOL LOCATIONS

D. Identify at least 10 locations where schools have successfully integrated the use of "personal computers" in the K-12 curriculum, particularly in the Northeast region.

The preceding section has documented a number and range of sites in the seven-state region that serve to demonstrate the integration of microcomputers into school programs. Rather than repeat descriptions, we refer you to section C, under the state headings.

Outside New England and New York, other programs exist that are worth mentioning briefly. We will describe a few.

The Oregon Council for Computer Education (OCCE)

Beginning in 1971 as a volunteer organization of 25 computer education enthusiasts, OCCE now numbers hundreds of individuals from every level of education all over Oregon. It is involved with teacher training, influencing state policy, linking colleges with schools, information sharing. It publishes a newsletter that has evolved into a unique journal for teachers (described earlier). It has been the chief impetus for a statewide task force on computing education.

Region IV Education Service Center, Houston, TX

Region IV actually serves three regions of the Texas education system, serving most of the student population of the state. It was established by the Legislature 14 years ago to provide services to schools in the region. The Region IV CAI staff have produced a booklet which is an excellent state-of-the-art resource to educators. The Center is collecting requests from region schools to put out a bid for microcomputers at low cost. In this regard they are following the MECC model described below. They will purchase $600,000 worth of microcomputers.

Minnesota Educational Computing Consortium

MECC is nationally known as the only statewide computer education agency. It provides computing services on a time-share basis, cooperative purchasing, teacher training, software and courseware development and sharing, information, a newsletter, and all manner of ancillary support systems. MECC has seven regional computer service centers. About a year ago, MECC decided to go microcomputer and settled on the Apple II (and now the Bell & Howell "black Apple") as the computer of choice. They reasoned that they could provide software and maintenance only to one type of Micro, although they recognize that schools will buy others that serve their particular needs better. MECC carried out an exhaustive study recently and put out a report, 1979-80 Microcomputer Report, which describes the specifications they agreed on (e.g., no cassettes--must have disk; graphics; etc.). This is a very useful research study and reference. Last year MECC bought 1,000 Apples, 100 in the last month alone, through an open bidding process. Through such a process, they are attempting to make the chaos of microcomputers in education more manageable.

MECC is now an agency of the SEA, the State University System, and the State Administrative Office, all of which send representatives to the governing board, which also includes users of MECC. MECC's policy is determined within limits and overseen by the Minnesota State Legislature.

Nebraska has its Educational Service Units, New York its BOCES, and Massachusetts its Regional Education Centers. Most are involved willy-nilly with microcomputers in education, through Title IV or other state or federal funding. They are worth looking at if one wants to build a picture of what is going on in school systems and administrative structures as far as the role of microcomputers in education is concerned.

STATE POLICIES FOR MICROCOMPUTER PURCHASE

E. Nationally, identify policies or program procedures that are being used by states to control or assist in the purchase of hardware.

This study turned out to be quite different from expectations because of the very nature of the American Democracy itself. In the last year, France has announced plans to purchase 10,000 microcomputers for installation in all its sc[illegible]s. England followed with a reported 4,000 microcomputers to be bought [illegible] its schools. In the United States, legislators shy away from any semblance of a national curriculum or mandated educational program policy because of the sacredness of local option. This is true on the federal level and it is just as true on the state level. A state may issue guidelines for microcomputer selection and purchase under a particular pocket of funding, or it may require approval of purchases over a certain amount, or it may research and recommend particular kinds of equipment or even particular brands of hardware. It refrains from requiring all schools districts to buy a single brand of microcomputer.

This has led to such policies as that of the SEA in Nebraska, where schools may buy what they wish, but the state-supported maintenance system will only service Apples. Cost-efficiency is maintained and local option is not denied. Effectively, however, schools are likely to buy Apples.

Similarly in Minnesota, which has the nearest thing to state-controlled educational computing (see section D, above), MECC services only Apples, although it assumes that communities already own or will buy other brands.

In some states, decisions fall de facto on intermediary offices or agencies. In New York, as we reported earlier, purchases of computing equipment must be reviewed by the state if they exceed $10,000. Similar constraints exist in other states. As a result, schools buy their micros out of other pockets to avoid losing state reimbursements. (This has become the situation in public

and private colleges, as well, where micros are bought out of department budgets to avoid going through the approval procedure for major equipment acquisition.)

Title IV guidelines obtain in many states. In Vermont, for example, the following policy has been promulgated:

VERMONT
ESEA Title IV-C

POLICY ON MINI GRANT APPLICATIONS
REQUESTING A COMPUTER/TERMINAL

A Mini Grant will be awarded to an elementary or a secondary school in a supervisory district/union for an educational program using a computer if:

A. There is no computer or terminal being used for instruction in an elementary school within the supervisory district/union if the application is for a project at the elementary school level.

B. There is no computer or terminal being used for instruction in a secondary school within the supervisory district/union if the application is for a project at the secondary school level.

C. The proposal includes an educational plan for use of the computer in curriculum areas and does not just address computer literacy.

D. The project includes a plan to share the project activities, results, etc. with other teachers in the district/union of the Mini Grant program.

E. The project meets all other Mini Grant criteria.

In New York, Connie Wettergreen reports that they have developed two de facto standards for schools: TRS-80 Level I for elementary schools; Apple Level II for secondary schools. This doesn't seem to have constrained either the BOCES or the schools from buying PETs, Compucolors, or other machines.

The nearest to control comes out of Raymond Sherrier's brilliant design for leasing micros and peripherals to schools with maintenance and state reimbursement built in (see section C); again it is de facto.

Texas seems to be following MECC's lead, and other states are planning to do so. While in each case, open requests for bids are circulated, the specifications are often so explicit that only one or two brands can match them. This does simplify software sharing and maintenance and gives an edge on purchasing and pricing.

What none of the existing approaches do is tackle systematically and purposefully the persistent problem of inequity between inner cities and affluent suburbs, or suburbs and rural districts. For this, a national priority and funding must be authorized. To date, this has not happened. At the April 1980 hearings of the Congress on Technology in Education, group after group made the point that the power of microcomputers in education is only beginning to be realized and that federal support must be given to providing equal potential for all schools and teachers and students.

A SOFTWARE DATA-BANK

F. Begin development of a data bank of educational software and user evaluations of software on a commercial time-shared system.

We have identified the evaluation and dissemination of educational software as major barriers to the large-scale use of microcomputers in education. To overcome this problem, we have begun a project to make descriptions and evaluations of programs available on a large, easily accessed data base. In addition, where possible, the programs themselves will also be available to be electronically transferred to local users.

The steps we have already taken are described in the following paragraphs.

The SOURCE (key S7 in the Appendix), a commercial vendor of time-share services, has been contacted, and use of their facilities has been explored in detail. SOURCE staff are enthusiastic about this use and have cooperated by giving us free access to their facilities. We have used their facility to store the Software Bibliography, to communicate with other SOURCE users with similar interests, and to store and retrieve programs.

After careful evaluation, we feel that other time-share vendors should be investigated. The SOURCE has recently had severe financial problems, which has caused a court-mandated reorganization. In addition, they have been very slow in communicating and seem unable to supply the utility programs our project requires.

We have formulated a plan for program evaluation. Because four other organizations -- LOCAL, Lesley College, MicroSIFT, and the Apple Foundation -- are currently launching similar efforts, we have delayed implementation of our evaluation so that we can cooperate and share with these projects.

Our data base will be called the Educational Software Exchange. It has been planned and announced in our newsletter Hands On! A copy of the announcement sent to over 10,000 educators is included in the Appendix. It describes the Exchange and how it will be used by teachers, software contributors, and vendors.

APPENDICES

Software Bibliography (A2)

Hardware (A10)

Sample Programs (A14)

Addresses of Organizations Concerned with Microcomputers and Education (A27)

State Surveys (A34)

Program Listings (unpaged)

SOFTWARE BIBLIOGRAPHY

Introduction

This Bibliography was prepared on a microcomputer, the Compucolor, so that it can be easily updated and searched. This fact has imposed some restrictions. First, to keep the memory requirements within reason, codes and abbreviations had to be used extensively. Secondly, the data had to be spread over six disks and cannot be searched between disks. As a result, the listing consists of six independently alphabetized listings, which are currently being merged on a larger machine.

The NREPP guidelines required a listing according to the following indicators: computer type, program language, grade level, objectives of the instructional program, location, cost, and purchasing information.

We have expanded this format to include several additional features: each program's description, its author, its discipline, its "style" (educational mode), any special hardware requirements, results of evaluations, related software programs (for cross-referencing), and literature references. These extra categories were added because they seemed important and because of the difficulty of adding categories to an existing data base. It is much easier to leave blanks and update later.

Codes and abbreviations

Many of the entries in the Bibliography are self-explanatory. Those that need explanation are described below. Each heading refers to an entry type in the Bibliography; the material under the heading defines the abbreviations used.

DISCIPLINES

BIOL	Biology	LIFE	Life sciences
BUSN	Business	MARK	Marketing
CHEM	Chemistry	MATH	Mathematics
CMI	Classroom management	PHYS	Physics
COMP	Computer science	POLT	Political science
ECOL	Ecology	PSYH	Psychology
ECON	Economics	RECR	Recreation
ELEC	Electronics	SCIE	Science
ENGL	English	SOCL	Sociology
ENGN	Engineering	STAT	Statistics
ENGY	Energy	TEAC	Teaching aids
GEOG	Geology	TYPE	Typing
LANG	Languages	UTIL	Utility program

LANGUAGES

AS	Assembly Level	PA	PASCAL
B	BASIC of unknown dialect	PL	PILOT
B0	BASIC (CONDUIT Level 0)	PC	PASCAL USCD
B1	BASIC (CONDUIT Level 1)	PL	PILOT
B2	BASIC (CONDUIT Level 2)	PM	PASCAL/M
BP	BASIC Plus	PT	PASCAL/MT
DC	DEC DECAL	P0	Tiny PASCAL
FO	FORTH		
F4	FORTRAN		
MA	Machine Language		

STYLE

CMI - Computer Managed Instruction

CAD - Computer Aided Design

CLASSIFICATION

Not used: reserved for future expansion

LC CATALOG

Not used: reserved for future expansion

LOWEST-GRADE

The estimated lowest useful grade level for which the entry is useful

HIGHEST-GRADE

The estimated highest useful grade level for which the entry is useful

MICRO-SUPL-COSTM

This entry contains codes for the microcomputer for which the program is available, the supplier of the software, its cost, and its distribution media.

The codes used for the microcomputers are:

A1	Rockwell AIM-65
A2	Apple II
A3	Apple III
AP	APF Electronics
B	Most computers using BASIC (indeterminate)
B0	Any common micro (CONDUIT Level 0)
B1	Any common micro (CONDUIT Level 1)
B2	Any common micro (CONDUIT Level 2)
C2	Compucolor II
C5	Any CPM using 5-1/4" disks
C8	Any CPM using 8" disks
D8	DEC PDP 8
DE	DEC PDP 11 family
DT	DEC System 10 or 20
K1	KIM-1
OS	Ohio Scientific (usually 4P)
P1	PET (indeterminate ROM)
P0	PET (Old ROM)
P2	PET (New ROM)
S1	Sorcerer (Exidy)
T8	TRS-80
TI	Texas Instruments 99/4
TE	Terak

The supplier codes are defined in the list of addresses in this Appendix.

The media codes are:

A - List on paper of assembly code

C - Standard audio cassette tape

D - 5-1/4 floppy disk

F - 8" floppy disk

L - List on paper of source code

M - Available for downloading via telephone modem

P - Punched paper tape

T - Tapes (9 channel magnetic tape)

MICRO-SUPL-COST2

If the same program is available for a second machine, the data are listed here using the same code as the previous entry.

DOC-SUPL-COST

If supplementary documentation is available, its supplier and cost are listed here. Codes used for documentation are:

M - Users' Manual

S - Student Manual

T - Teacher Manual

I - Implementation Manual

Again, the supplier codes are given in the list of addresses.

ON-THE-SOURCE

States whether or not the program can be down-loaded from the SOURCE

IN-TERC'S-C.R.C.

States whether a copy of the program is available for inspection at TERC's Computer Resource Center.

How to read a sample listing.

```
NAME                    A ADDITION
DESCRIPTION             A PRESENTS VERTICAL ADDITION PROBLEMS IN
OBJECTIVES              A 4 DIFFICULTIES
AUTHOR                  A
DISCIPLINES             A MATH
STYLE                   A DRILL
CLASSIFICATION          N 0
L.C.CATALOG             A
LOWEST-GRADE            A 3
HIGHEST-GRADE           A 12
LAGUAGE                 A B
MICRO-SUPL-COSTM        A T8 L1 $3 C
MICRO-SUPL-COST2        A P1 L1 $3 C
MICRO-SUPL-COST3        A
DOC-SUPL-COST           A NONE
SPECIAL-REQUIRMT        A NONE
RELATED-PROGRAMS        A NONE
LITERATURE-REF.         A NONE
ON-THE-SOURCE?          A N
IN-TERC'S-C.R.C.        A N
ROUGH-EVALUATION        A
EVALUATION-CODE1        N 0
EVALUATION-CODE2        N 0
COMMENT#1               A PROGRAM #C0015
COMMENT#2               A
```

Using the codes, this listing reveals that the program ADDITIOM presents vertical addition problems in four levels of difficulty. It is a math drill problem useful in grades 3-12, written in BASIC. It is available on the TRS-80 from supplier L1 for $3.00 on cassette tape. The address list reveals that L1 is Project LOCAL, 200 Nahatan Street, Westwood, MA 02090.

The same program is also available for the PET. There are no documentation, special hardware requirements, related programs or literature references. It is not available on the Source or TERC's computer Resource Center. The program has been given number C0015 by Project LOCAL.

EDUCATIONAL SOFTWARE EXCHANGE

With the advent of microcomputers it is economically feasible to give every student access to a computer. However, the educational potential of computers is far from being realized because there is a dearth of good educational software. What is available comes from a profusion of different vendors, is of widely varying quality, and is very hard to preview.

We are trying to bring some order into this chaotic situation by making a uniform listing of all available educational software, along with teacher evaluations, other software, and where possible, the software itself. All of this information will soon be placed on line; this means that you can use a terminal or your microcomputer to look for just the kinds of programs you are interested in, read teacher evaluations of these programs, and then, in many cases, immediately get hold of a copy of the program and run it through to see if it is satisfactory for the intended application. With this same system, you will be able to contribute programs and reviews.

We are currently setting up the technical and administrative machinery that will make all this possible, but equally important is the network of contributors and users for the system. If you are interested in being part of this network, be sure to check the appropriate box on the Reader Response Form at the end of this newsletter. There are four different ways you might join the network: as a user of the information, as an evaluator of programs, as a software contributor, and as a vendor who may list software available elsewhere. In the paragraphs below, we will describe how the Software Exchange is currently planned to be used from the perspective of each of these types of users.

A teacher looking for software. You first must subscribe to the data base. This entails a one-time charge. In addition to enabling you to sign onto the software data base, this charge also permits you access to many other data bases and provides for a newsletter, a packet of information, and programs that are required to use the data base.

The next thing you need is some hardware. You can communicate with the data base either through a terminal, such as a Teletype, or through a microcomputer executing a program that converts it into a terminal. Whichever device you use, it needs to be able to talk over a telephone, using a device called a modem (for modulator/demodulator). A modem suitable for connection to either a microcomputer or terminal costs approximately $150.

With this hardware, you can dial the data base. The number you call depends on where you are located in the country. The data base is accessed through a commercial network that has telephone outlets in many major American cities. If you are a resident of one of these cities, it will be a local call; if you are not, it will be a long distance call to the nearest city.

Once you have signed on, a few simple commands will give you access to a program that searches our data base for the names of programs that fit your criteria. For instance, suppose you are interested in games that might apply to general science at the junior high level and that run on an Apple II. If there are any such programs in the data base, you will be given their names and educational objectives. Suppose one of these programs looks interesting—your next step would be to see its evaluation. While all programs in the data base will have been reviewed, some will obviously be better than others, and you might be interested in seeing what the teachers who evaluated this program felt about its educational utility. The evaluation file on the program you are interested in can be examined either in summary or detail. If you are convinced that this program is worth looking at, you can make a request that it be loaded into your machine from the data base. To do this you will be given instructions on how to make your computer able to accept the desired program in executable form. The transfer of the program to your machine will entail a small purchase charge (perhaps $5), which goes partly for author royalties, partly for program maintenance, and partly to help support the evaluation process.

As soon as the program is loaded into your computer, you can execute it and save a copy of it for later use with your students. You have now bought a copy of the program and it is yours to use in exactly the way you would if you had purchased it in tape or disk form.

We will be working on a way of permitting you to preview the program before purchasing it. Preview facility will permit the program to be executed by the computer that supports the data base, with the results being sent to your computer, so that input and output are generated in much the way they would be if you were executing the program at your machine. However, the source code for the program stays at the data base. As a result, you do not have to incur any purchase charges and will not encounter the delay entailed in shipping the entire program to you.

If, after using the program, you feel that it can be improved or that the evaluations were inaccurate, you will be given a chance to make your opinions known by entering them into a "comment" data base. These comments will be regularly reviewed, and appropriate action will be taken, either to improve the programs or to make the descriptions of them more accurate. Because this is an on-line data base, the process will continue to evolve and improve itself as better information is made available.

If you want to submit a program, you will also do it electronically through the data base. You will be given instructions to enter the program in a special input file that is not publicly accessible. You will supply all the information needed to permit other users to find your program and will load your program into that file. Your program will then be reviewed and you will be mailed the results of that review. The program will be either accepted, rejected, or accepted after certain changes are made. Once the program is accepted into the on-line data base you will receive a royalty each time the program is sold by downloading into another user's machine. If user comments indicate that program modifications are required, you will be asked to make these modifications.

If you are a vendor and you wish to list only the description of programs which users must purchase from you, we will ask you to qualify by sending us your complete catalog and copies of any programs that you want described. We will have these programs evaluated and, if we feel that they are meritorious, will prepare and enter a description of these programs into the bibliographic data base. The programs themselves will be kept in our Computer Resource Center for inspection but will not be reproduced without your authorization. In this way, teachers will have a uniform way of finding programs that may be of interest. If you as a vendor are willing to distribute the programs at the low rate that authors accept, your programs can be added to the file of programs that can be down loaded. Perhaps in the future, if there is sufficient interest, we will develop the capacity of having variable sales prices that each vendor can set.

If you want to evaluate a program, you can let us know through the data base. We will ask you to enter into a file (electronically, of course) a description of the kinds of programs you feel qualified to evaluate. When such a program comes along you will be notified and given free access to the submitted program. Once you complete the standard evaluation procedure and enter that information into the evaluation data base, you will be sent a small honorarium for your efforts.

A JOURNAL FOR TEACHERS

The Computer Teacher is a journal for people interested in the instructional uses of computers at the pre-college level. Under one or another title it has been published since May 1974. It is now published six times a year, with each issue typically 50-60 pages long. Subscriptions are $8/yr., which should be sent to ***The Computing Teacher*** (c/o The Computing Center, Eastern Oregon State College, La Grande, OR 97850).

FEDERAL SUPPORT(?)

In June, Representative James Scheuer introduced a bill to establish a national commission to study the scientific and technological implications of information technology and education. That bill, labeled HR4326, has been referred to the committees on education and labor, and science and technology. Among other things, it calls for related educational research and development, testing and dissemination of effective approaches, the creation of regional demonstration test centers, and the study of long term effects of computers in education. Readers are urged to request the text of this bill from their Congressperson and to express their opinions about it.

EDUCATIONAL SOFTWARE

Teachers interested in educational software for microcomputers should consult ***Robert Purser's Software Directory*** (Box 466, El Dorado, CA 95623). It is published quarterly at $12 per year. Robert Purser prepares a long (90 + pages) newsprint software directory, which includes a substantial number of educational programs along with his own editorial reviews, which are extremely useful guides to the level and value of the program.

A good vendor of educational software is a company called Microphys (2048 Ford Street, Brooklyn, NY 11229). Microphys has over 100 cassettes, costing $20 each, designed to run on the Commodore PET. There are programs in physics, chemistry, junior and senior high school math, and vocabulary. The cassettes are also soon to be available for the TRS 80 level 2. We have not had a chance to review these programs, so we can only pass on the advice from Robert Purser: order a few of the cassettes and get a feel for how they fit into your classroom.

Other sources for educational software to which readers should reply directly are ***Cursor Magazine,*** Box 550, Goleta, CA 93017; ***CLOAD Magazine,*** Box 1267, Goleta, CA 93017; Solartech, Box 298, Guilderland, NY 12084; Sterling Swift Publishing Co., Box 188, Machacha, TX 78652; Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, MN 55113; The Software Factory, 515 Park Street, Anoka, MN 55303.

HARDWARE

This section describes the microcomputer hardware available to schools. Except for the KIM, AIM, Compucolor, and S-100/CPM machines, the descriptions are used with permission of Russ Walter and appear in his excellent booklet The Secret Guide to Computers (volume 3, Tenth Edition, 1980). A detailed comparison of available hardware can also be found in the Minnesota Educational Computing Consortium (MECC) Microcomputer Report for 1979-80.

A CHART FOR COMPARISON

This chart compares 16 microcomputers; all of them work well; each one has its own peculiar advantages:

Manufacturer	Model	Base price	User RAM included	Higher price	Price includes keyboard?	Price includes video?	Price includes tape recorder?	Price includes disk drive?	Draws pictures in color?	Graphics characters on keyboard?	Accepts ROM cartridges?	Lower-case letters on screen?	Convenient touch-typist keyboard?	Invent your own characters?	Uses co-ordinates for graphing?	Easy high-resolution graphing?	Lines of text on screen	Characters per line	Type of CPU
Ohio Scient.	Challenger 1P	$349	4K	unpublished	Y	N	N	N	N	N	N	Y	Y	N	N	N	30	30	6502
Atari	400	$550	8K	unpublished	Y	N	N	N	Y	N	Y	Y	N	N	Y	Y	24	40	6502
Radio Shack	Model 1 Level 2	$619	4K	$849 if 16K	Y	Y	Y	N	N	N	N	N	Y	N	Y	N	16	64	Z-80
Ohio Scient.	Challenger 4P	$698	8K	unpublished	Y	N	N	N	Y	N	N	Y	Y	N	N	N	32	64	6502
Commodore	C	$795	8K	$1195 if 32K	Y	Y	Y	N	N	Y	N	Y	N	N	N	N	25	40	6502
Commodore	N or B	$795	8K	$995 if 16K	Y	Y	N	N	N	Y	N	Y	Y	N	N	N	25	40	6502
Atari	800	$1000	8K	$1125 if 16K	Y	N	Y	N	Y	N	Y	Y	Y	N	Y	Y	24	40	6502
Texas Instr.	99/4	$1150	16K	none	Y	Y	N	N	Y	N	Y	N	N	Y	Y	N	24	32	9900
Apple	2-plus	$1195	16K	$1345 if 32K	Y	N	N	N	Y	N	N	N	Y	N	Y	Y	24	40	6502
Exidy	Sorcerer	$1295	16K	$1395 if 32K	Y	N	N	N	N	Y	Y	Y	Y	Y	N	N	30	64	Z-80
Compucolor	2	$1595	8K	$1895 if 16K	Y	Y	N	Y	Y	N	N	N	Y	N	Y	N	32	64	8080
North Star	Horizon	$2695	32K	$3434 if 64K	N	N	N	Y	N	N	N	Y	Y	N	N	N	24	80	Z-80
Heath	WH89 + H89-17	$2795	16K	$2945 if 32K	Y	Y	N	Y	N	N	N	Y	Y	N	N	N	25	80	Z-80
Intertec	Superb.+BASIC	$3345	32K	$3695 if 64K	Y	Y	N	Y	N	N	N	Y	Y	N	N	N	25	80	Z-80
Radio Shack	2	$3450	32K	$3899 if 64K	Y	Y	N	Y	N	N	N	Y	Y	N	N	N	24	80	Z-80
Vector Gr.	MZ	$4313	64K	none	N	N	N	Y	N	N	N	Y	Y	N	N	N	24	80	Z-80

The "base price" is the list price of the smallest combination that includes a decent version of BASIC. Some dealers charge less than the base price. You'll have to pay *more* than the base price if you want more RAM, or if you want a fancier version of BASIC, or if you want other extras. For some computers, the base price does *not* include a keyboard or video or tape recorder or disk drive; for other computers, the base price includes most of those items; look at the columns marked "Price includes...".

If the base price includes a keyboard but doesn't include video, you must buy an ordinary television set (with an RF modulator) or a modified television set or a television monitor. If the base price includes *neither* a keyboard nor video, you must buy a terminal.

RADIO SHACK

Radio Shack's TRS-80 Model 1 computer is the most popular microcomputer ever manufactured by anyone. Though Radio Shack won't release exact figures, most industry analysts estimate that Radio Shack's sold 200,000 TRS-80 Model 1 computers, and that the figure of 200,000 is much more than *all* other manufacturers combined.

Radio Shack also makes a TRS-80 Model 2. But because it costs so much more than the Model 1, it isn't as popular.

Both models of the TRS-80 contain a Z-80 CPU and use a black-and-white video. Radio Shack is rumored to be preparing a TRS-90, which will contain a 6809 CPU and use a color video.

Model 1

The base price for the model 1 is $499. It includes the main cabinet, a 12" black-and-white monitor (made by RCA), a cassette tape recorder, and various aids: an AC/DC power transformer, an easy-to-read cheery instruction book, and a tape that contains programs for blackjack and backgammon.

The main cabinet includes a Z-80 CPU, a built-in keyboard, a 4K ROM (that contains Level-1 BASIC), a 4K "user" RAM (for your programs), a 1K RAM for the keyboard, and a 1K RAM for the video.

COMMODORE PET

Commodore's PET costs about the same as Radio Shack's TRS-80, but is better in several ways. It's especially popular among high-school teachers. Here's why....

The PET is easy to carry from classroom to classroom, because its main cabinet contains everything— even the video and the tape recorder. (The TRS-80 is more awkward to carry, because it consists of four separate pieces— the main cabinet, the video, the tape recorder, and the AC/DC transformer, which are connected by ugly wires that tend to get tangled and confused. The Apple is awkward also.)

The PET is theft-proof. (The average thief wouldn't know how to use or resell a stolen PET. If you buy a TRS-80 instead, which has a separate tape recorder, the tape recorder will probably get stolen quickly. If you buy an Apple with a color TV, you can expect to lose the TV.)

When you make an error, the PET (like the Apple) prints a complaint that's written in easy-to-understand English. (The TRS-80 prints a two-letter code instead, which confuses the students.)

The PET includes a high-quality full-screen editor, which lets you revise your programs quickly and easily. (Its editor is much better than the TRS-80's, and even beats the Apple's.)

The PET's unusual keyboard has five kinds of symbols: upper-case letters, lower-case letters, punctuation, mathematical symbols, and graphics characters. (The Apple and the TRS-80 lack lower-case letters, and also lack graphics characters.) Therefore, the PET is superior for writing messages (which require lower-case letters) and for games (which require graphics characters).

The PET's tape recorder is reliable (unlike Radio Shack's). Moreover, you can name each program on the tape, and retrieve the program by mentioning the name. (Apple's computer doesn't let you name your taped programs. Radio Shack's computer permits "names", but each name must be just one letter!)

To encourage schools to buy the PET, Commodore had a "sale": if a school would buy two PETs, Commodore would give the school a third PET *for free*. Many schools took advantage of that "three for the price of two" sale. Notice that at three-for-the-price-of-two, the price per PET becomes $530, instead of $795. A PET for $530 was definitely a better deal than what Radio Shack and Apple were offering. Officially, that sale has ended; but if you're lucky, maybe you can twist the arm of your local computer dealer, to give you a discount anyway.

APPLE

Radio Shack is the most popular microcomputer company, mainly because Radio Shack's TRS-80 Model 1 costs so little, and because Radio Shack owns so many stores. Apple ranks second in popularity— because the Apple costs slightly more, and is sold only through independent dealers. But many people feel that the Apple is indeed worth the extra cost, and is a better deal than the TRS-80. The Apple is more reliable. The Apple comes with manuals that are written better. Apple's disk system is easier to use. The Apple can draw higher-quality pictures, and can also handle 16 colors. (The TRS-80 draws just black-and-white.) The Apple is sold through computer stores, where the salesmen know a lot about computers and can give you lots of help. (The TRS-80 is sold mainly through ordinary Radio Shack stores, where the salesmen know lots about radios and stereos but little about computers.) If your Apple ever needs repairs (which are extremely rare), your local Apple dealer will usually be able to fix the Apple immediately, by himself. (A Radio Shack store must ship the computer to a repair center.) The Apple has been selected by the state of Minnesota, as *the* computer for teaching kids; many schools in Minnesota have been writing programs for the Apple. (No organized movement exists for the TRS-80.) The Apple includes a built-in speaker, which makes "clicks", and which you can program to produce nice music. (Producing nice music on the TRS-80 is much harder.) The Apple includes game paddles, which you pull back and forth during games that involve motion. If you type a program that contains an error, the Apple prints a complaint that's written in easy-to-understand English. (The TRS-80 prints a two-letter code instead, unless you have a disk.) The newest Apple includes a "full-screen editor", which lets you revise your programs quickly and easily. (Revising a TRS-80 program is more awkward.)

COMPUCOLOR

The Compucolor is a compact, attractive computer complete with a disk drive and a crisp color monitor. It has a detachable keyboard with many special convenience keys. Its BASIC is unusually complete and a growing collection of software is becoming available. In many respects, the Compucolor is a superior machine. Unfortunately, they have no dealers in the Northeast and have been plagued with hardware problems. As a result, they are not found in a significant number of Northeast schools.

THE KIM

The KIM is an inexpensive ($179) single-board computer made by Commodore, the manufacturers of the PET. Because of its limited 1 kbyte memory it does not support BASIC and must be programmed in machine code. It makes an excellent laboratory and control computer and is used in electronics courses to teach hardware concepts.

THE AIM

The AIM is an upgrade of the KIM made by Rockwell International. It is available with enclosure and power supply from the Computerist for $485.00. It maintains hardware and software compatibility with the KIM but offers a full keyboard, 20-character readout, and a small printer, and BASIC.

S-100/CPM COMPUTERS

The S-100/CPM computer is not actually one computer; it is a series of components that adhere to two simple standards -- the S-100 bus and the CPM operating system. The S-100 standard defines how hardware in the form of boards can be interconnected. There are over 200 different S-100 compatible boards on the market; everything from simple standard CPU boards to sophisticated speech and image processing equipment. The CPM standard defines how software interacts with hardware. An extremely broad variety of languages and applications programs are available that can be run on any hardware configuration supporting CPM. S-100/CPM machines are the third most popular type of microcomputer, but are not widely used in schools.

Glossary of hardware terms

bit	The smallest unit of information represented as a digital signal inside a computer.
byte	Eight bits of data that are used as a unit by a computer.
CPU	Central processing unit - the microprocessor and supporting circuits.
K	Abbreviation for 1024, usually in reference to bytes of memory.
Kbyte	A unit of 1024 bytes.
RAM	Random access memory, usually refers to memory that can store programs and data.
ROM	Read-only memory, used to store routine programs used in computer operations.
video	Usually refers to a TV-like output display device.

Buggy Grades 4-8

Runs on Apple II. Available from the Apple Computer Company.
Disciplines: Quantitative Reasoning, Applied Science.

Description. Buggy is a program that simulates the kinds of mistakes, or bugs, that students often make in calculations. A typical example is forgetting the carry from one column of addition to the next.

Use. In one session, Buggy will consistently make the same mistake in a type of calculation (e.g. addition or subtraction). The student generates problems for the computer with the goal of tracking down the bug. When students think they have the bug, the computer tests their understanding by posing five problems and asking for the "buggy" answer: the result using the bug. If these are correct, the computer gives a description of the bug. At this point, students can continue with the computer randomly generating a different bug. The program is suitable for use with a group of students who can hypothesize together and jointly decide on good tests of their hypothesis.

Educational Value. Buggy obviously gives practice with calculations, but more important, it also helps students break calculations down into a series of steps and make them more aware of these steps. Buggy embodies the essence of the scientific method of framing, testing, and refining hypotheses. As such, it is an excellent model for scientific problem solving. Finally, Buggy gives students practice putting mathematics into words and thus explores the overlap between quantitative and verbal skills.

Cooling Curve Grades 8-12

Runs on a KIM-1. Available from TERC Services, 8 Eliot Street, Cambridge, MA 02138.
Disciplines: Physical Science, Applied Mathematics, and Laboratory Skills.

Description. This program illustrates the use of microcomputers as laboratory instruments and is representative of a large class of applications where the computer is used to gather, analyze, and display data from a real, not simulated, experiment. These applications are seen as important because much of the busywork associated with many traditional labs can be transferred to the microcomputer, freeing the student to focus more directly on the underlying science.

The Cooling Curve Experiment is a traditional part of several popular 8-12th grade physical science courses. In the usual experiment, students record the temperature, over 20 minutes, of a sample of moth flakes as they cool through a liquid-solid phase change. These data are then plotted and the graphs discussed for their physical significance. The entire experiment requires well over an hour and requires so much data manipulation that students usually miss the underlying science.

Use. With the KIM and suitable interface circuits, the experiment can be speeded up using a smaller sample. The program gathers the data and displays a graph of the temperature history as the experiment proceeds. Several different experiments performed under various conditions are feasible within one period. The KIM even stores and displays the results of a previous run for ease of comparison.

Educational Value. The primary advantage in adding the microcomputer to this experiment is that phenomena of the experiment are more clearly and forcefully revealed to students. This is the often overlooked role of the lab: to provide the phenomenological basis for scientific theory. This method of using computers is, in itself, important because it reflects current practice in science and engineering.

Exponential Function Grades 10-14

Runs on Compucolor. Available from Compucolor.
Disciplines: Modeling, Economics, Ecology, Natural Science, and Applied Mathematics.

Description. Exponential Function is a program which demonstrates one of the fundamental concepts of natural and applied science, in a highly dramatic and flexible fashion. Based on the relations of quantities to rates of increase, the program generates graphs, tables, and other data displays to make countless comparisons and illustrate alternatives, building interactively on instructions initiated by the student.

Use. A striking example of the computer's power to dramatize and explain complex phenomena, Exponential Function can be used in many curricula examine processes ranging from bacterial growth and nuclear radiation, to agricultural economics, demography, laboratory experiments, and urban planning. In a typical demonstration, the program generates a series of graphs which comprise a model of a nation's economy. Different processes can be monitored over time, or compared and contra ted (e.g., GNP and its relationship to productivity) . A further application is to compare whole systems to one another. Since the graphs and tables can be manipulated readily to provide overlays and other useful projections, the program functions as an extremely flexible teaching tool. It works best with students who have reached the levels of pre-calculus and intermediate algebra.

Educational Value. The basic program can be applied to literally countless examples of exponential processes in nature and in human society. Using the computer's strengths of speed and flexibility in the handling of large amounts of data, the program provides a vital adjunct to the teacher's instructional menu. It is equally effective with upper division high school students or first and second year college students.

Ghetto Grades 9-12

Runs on Apple II, TRS-80, and PET. Available from CONDUIT.
Disciplines: Social Studies, Economics, Modeling.

Description. The Ghetto simulation is designed to sensitize its players to the emotional, physical, and social world the disadvantaged inhabit. Players assume the role of one or more of ten "ghetto" residents, and experience vicariously the economic pressures that drive prople into crime, welfare, and community action.

Use. The players attempt to improve their lives by investing hours in various activities and collecting as many reward points as possible. Each ghetto resident is described by sex, age, marital status, level of education, number of children, and number of hours to invest. Investments may be made in school, work, hustling (illegal activity), relaxation, and welfare. As capricious events occur which negate the player's investments and reduce or eliminate reward points, the player experiences frustration akin to the frustrations of the disadvantaged.

Educational Value. A powerful simulation closely built upon real-world conditions, Ghetto offers a challenging and complex portrayal of inner-city life and its effects. Combined with other materials, such as newspapers and films. or used by itself, the program imparts a life-like element to the statistics and other data typically used in social studies curricula, enabling the students to identify with the dilemmas and limited choices confronted by people who must cope with inherently difficult and even impossible life situations. Understanding the complexity of the urban scene and large social systems, strategic and decision-making skills are among the specific aims of the program.

GRASIC Grades 6-12

Runs on a S-100/CPM computer. Available from Cambridge Development Laboratory, 44 Brattle Street, Cambridge, MA 02138.
Disciplines: Computer Science, Mathematics, and General Problem Solving

Description. GRASIC is a version of BASIC that includes Turtle Graphics commands, such as MOVE, TURN, and HOME. With these additional commands, students can draw figures on the computer display.

Use. Students with no programming experience can draw figures by simply typing the appropriate commands. The immediate feedback from seeing the result of the command is an important element in learning to control the computer. From this simple beginning, the transition to programs, loops, variables, and other BASIC language constructs is easy and well motivated. Because GRASIC is a general-purpose programming language, there is no practical upper limit to the educational applicability of this software. Graphs, projections, and complex calculations can be generated in the language.

Educational value. Learning to program is one of the most important skills that can be acquired with a computer. It is useful in its own right, but also develops mathematical ability, problem-solving skills, and logical thinking. GRASIC provides an easy environment for learning programming that has been proven effective.

Hangman Grades 1-8

Runs on TRS-80, PET, Apple II, and Compucolor. Available from Compucolor and several user groups.
Disciplines: English, Spelling, Vocabulary, and Foreign Languages.

Description. A game-style program based on a popular format for teaching spelling and word structure. Hangman offers an enjoyable format for learning how words are built and the relations of vowels and consonants, and developing vocabulary. There are two levels of word difficulty available to choose from.

Use. Students may play alone or take turns, trying to guess the letters which spell a word before the computer completes the segmented figure of man being hanged;the man "grows" according to how many wrong guesses the student makes. The program allows the teacher to set certain exercises, and even to substitute words from any Roman-alphabet foreign language in the format.

Educational Value. A straightforward, simple and enjoyable spelling and vocabulary builder, Hangman is an example of a drill-and-practice program that generates and reinforces student involvement.

Lemonade Stand/SELLLEMONADE Grades 4-8

Runs on Apple II and TRS-80. Available from DISCUS, Creative Computing, and various user groups.
Disciplines: Social Studies, Mathematics, Simulation, and Career Education.

Description. One example of a popular elementary and junior high series of program, Lemonade Stand has been developed in several commercial versions. The Huntington 2 version, SELLLEMONADE, is the third in a graded sequence of programs (the others are SELLAPPLES, SELLPLANTS, SELLBICYCLES, and MARKET) which illustrate how businesses operate and how economics has "real-life" meaning - for children it is an accessible means of teaching about product pricing, advertising, consumer awareness, and economic competition.

Use. SELLLEMONADE simulates the running of a lemonade stand. The students decide how much lemonade to make each day, how much advertising to do, and how much to change. There is no direct competition between stands, but many different stands can be running the simulation at once and competition naturally develops. Random, unexpected events add to the realism as the students may experience thunderstorms, cool days, street repairs, and other predicaments.

Educational Value. These simulations were developed as an attempt to let the students experience the business world without adults telling them how not to make mistakes. Specific business concepts can be focused on one at a time, and students have a chance to try their own methods to see how they might work. They also learn to cope with uncontrollable events that force them to analyze a situation. The computer simulation opens many avenues for individual tinking that we often suppress in the real world. These sequences may be built into a variety of math, social studies, and other courses, with teachers encouraged to adapt them to particular topics and broader concepts. Documentation is also available in the form of teacher and student manuals, and an implementation guide, which allow for varied applications.

Milliken Math Sequences Grades 1-6

Runs on TRS-80, Apple II, and PET. Available from Milliken Publishing Company
Disciplines: Mathematics.

Description. A complete set of elementary mathematics courses, designed to teach arithmetic and reasoning concepts and skills in a clear step-by-step fashion. Distributed on twelve 5-1/4" floppy disks or cassettes, and equipped with supportive instructional materials and guides, the program enables the teacher to track and manage the student's progress carefully. The package covers all of the essential basic skills, including addition, multiplication, division, factoring, elementary set theory, measurement and elementary geometry.

Use. The Milliken programs provide clear explanations of each type of mathematics problem. Typically, the student will be asked to demonstrate his/her knowledge of each aspect in stages, through a series of appropriate problems. The sequences are constantly interactive, providing feedback at each point of error; if after repeated tries the student still has difficulty, the program will retrace the necessary steps. Working with this package gives an excellent demonstration of the principle that, with microcomputers, the more clearly defined the teacher's objectives are, the more likely they are to be achieved.

Educational Value. The Milliken materials provide both the teacher and student with a coherent and flexible approach to learning mathematics. The programs are characterized by strong reinforcement of the student's efforts, combined with an element of anticipation and suspense. Pedagogically, these sequences represent an application of "Branching CAI" (computer-assisted instruction), a variation on many first-generation computer teaching methods, which were more restricted in their capabilities.

Star Trader Grades 7-11

Runs on Compucolor, Apple II, and PET. Available from Compucolor.
Disciplines: Economics and Modeling.

Description. Illustrating the imaginary economic system of an interstellar civilization, Star Trader provides the student with a dramatic, dynamic conception of the interaction of resources, planning, marketing, and distribution practices.

Use. From two to four players operate starships in competition with one another, traveling between star systems, buying and selling merchandise. The star systems vary greatly in their stage of development and in their main products; players must constantly make bargaining choices and estimate potential gains and losses. The overall system evolves over time, with extensive monitoring of financial gains and losses, the status of each product and sub-economy, and rapid evaluations of the players' fortunes.

Educational Value. Particularly useful in economics and social studies, Star Trader helps students develop perceptions and reasoning abilities through the weighing of variables, probabilistic judgments, and bargaining, enhancing their awareness of economic limits, general modeling, and decision-making problems, and providing a vivid sense of the interaction of complex systems. It provides a highly enjoyable, fast-paced format for learning. Questions and comparisons applied to real-world economics and planning situations are readily suggested by the challenges, frustrations, and rewards inherent in Star Trader.

Synonyms (IQ Builder) Grades 8-12.

Runs on Compucolor, PET, Apple II, and TRS-80. Available from Program Design, Inc.
Disciplines: English, Language Skills.

Description. One member of the IQ Builder family of programs (including Analogies and Antonyms), Synonyms is a widely-used package for teaching English language skills, vocabulary, and practice for tests such as the SAT.

Use. Its primary mode is drill and practice, in a multiple-choice format, with a very clear exposure to certain problems of grammar, linguistic reasoning, and the excitement of working with word choices and analogies. Synonyms is designed for a single user, but students may take turns in a game-like approach. It is best utilized in conjunction with the broader elements of English and language arts courses (integrated with composition, reading, spelling, and grammar).

Educational Value. This program and its partners are highly useful for building and reinforcing basic language skills, plus providing vivid, non-threatening practice in test-like simulations. As a group, these language programs are representative of a vast pool of similar software, adaptable to any school's curriculum.

Three Mile Island Grades 4-12

Runs on Apple II; distributed on disk by Muse Software Inc.
Disciplines: Ecology, Economics, and Applied Sciences.

Description. As the name implies, this program is about nuclear power, on issue of obvious currency and importance. The program simulates the operation of a nuclear plant (not necessarily Three Mile Island) and gives control of the major parts of the plant to the computer user. The simulation includes control of the reactor core, the generators,and cooling systems, and computes the power generated and the profits earned during a speeded-up day. Problems crop up randomly such as varying demand for electricity, filter clogging and value, and turbine and pump and instrument failures Unless the correct procedures are observed, the core can overheat and melt down. To get through a day without meltdown, it is necessary to establish a preventative maintenance schedule for critical parts and to react promptly and accurately to emergencies as they occur.

Use. During a typical session, the student uses the computer to view one of several scenes and status boards to gain information about the plant. One scene in beautiful color graphics details the reactor core and the positioning of the central rods within it. Other scenes show the reactor containment vessel containing the core and its primary cooling system, the electrical generation facility, the instrumentation, the repair status of equipment, and a profit/loss statement. An audible beeper ticks away a minute each second and warns of trouble in the system. The student alternates between tracking down and anticipating trouble by flipping between scenes and then curing problems by controlling and repairing equipment (e.g. forming a value on or off). If a meltdown occurs, the user is treated to a spectacular graphics depiction of the event.

Some teacher interaction is required to get students started using Three Mile Island but once launched, students learn on their own.

Educational Value. It is surprising how quickly young children can learn to operate this complex system and get a feeling for the dynamics of the physical, economic, and managerial issues. We have seen kids as young as seven completely absorbed in this simulation for hours.

Knowledge in a variety of areas is necessary for successful operation: a technical vocabulary that is in the news such as "emergency core cooling system,"technical ideas such as closed systems and heat flow, economic concepts,such as fixed and variable costs, and management concepts, such as preventive maintenance.

The program has some drawbacks: it is quite slow in parts and gives an unrealistic picture of the dangers of nuclear plants. Because it is so slow, several class periods may be required before significant learning takes place.

Typing Tutor Grades 6-12

Runs on Apple II and TRS-80. Available from MicroSOFT.
Disciplines: Typing and Computation.

Description. An interactive program that teaches the workings of a computer keyboard, and typing skills, and helps the student build typing speed and efficiency. The program develops the student's abilities in a logical sequence and monitors progress constantly.

Use. Typing Tutor uses a drill and practice mode and covers the full range of techniques required for both basic training in typing and effective mastery of the microcomputer keyboard. The program provides lucid feedback to the student, highlighting errors of spelling, syntax, spacing, etc. The teacher may choose to reinforce the program by means of supplementary exercises.

Educational Value. It is an excellent skill builder and helps the student acquire essential ease and familiarity with the logic and operation of any computer program. Some teachers contend that every student should master this program, to lay the foundation for proper typing habits in using computers. The student can avoid many problems by making a strong start in this skill area. Typing Tutor makes an excellent use of the general flexibility of the computer by transforming it into an actual typing teacher.

ADDRESSES OF ORGANIZATIONS CONCERNED WITH MICROCOMPUTERS AND EDUCATION

AØ Apple CAI/CMI
Ted Perry, Coordinator
5848 Riddo St.
Citrus Heights, CA 95610
(916)961-7776
(Computer assisted instruction for Call Apple Users Group.)

A1 ACORN Software Products, Inc.
634 North Carolina Ave., S.E.
Washington, D.C. 20003
(202)544-4259
(Daphne Shor)

A2 Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, CA 95014
(408)966-1010

A3 Advanced Graphics
James Garon
920 W. Romneya #6
Anaheim, CA 92801

A5 Atari
1265 Borregas
Sunnyvale, CA 94086
(800)538-8547 in California

A6 Apple P.I.E. (User Group)
800 West Utah Ave.
Hildale, Utah 84741
(801)874-2262

A7 Apple Portland Program Library Exchange
1915 N.E. Couch
Portland, OR 97232
(503)233-5711

A8 Amateur Computer Group-New Jersey
U.C.T.I.
1776 Raritan Rd.
Scotch Plains, N.J. 07076
(201)277-2063

A9 Call-Apple
Frederick W. Merchant, Secty.
517-11th Ave. E.
Seattle, WA 98102

AC ACM Assn. for Computing Machinary
1133 Ave of the Americas
New York, NY 10036
(212)265-6300

AF Apple Foundation
20605 Lazaneo Dr.
Cupertino, CA 95014
(408)996-1010

AI Adventure International
Scott Adams
Box 3435
Longwood, FL 32750
(305)862-6917

AL The Apple Core
Box 4816
San Francisco, CA 94101

AP APF Electronics
444 Madison Ave.
New York, NY 10022
(212)758-7550
(New England rep. is U2)

B1 The Boston Computer Society
17 Chestnut St.
Boston, MA 02108
(617)227-9178
(Jonathan Rotenberg)

BH Bell & Howell
Audio Visual Products Div.
7100 McCormick Rd.
Chicago, IL 60645
(312)673-3300
(Developer of B&H software for CAI CMI, etc.. Market "black" Apple2

computers.)
New England rep. is U2

BL BLS
2601 Silverside Rd., Suite One
Wilminton, DE
(over 200 courses planned for '80-81. Disk based for BH and A2.)
(New England rep. is U2)

C1 Creative Computing Software
P.O.Box 789-M
Morristown, NJ 07960
(800)631-8112
(in NJ (201)540-0445)

C2 Compucolor Corp.
P.O.Box 566
Norcross, GA 30071
(404)449-5996
(Manufactures computer systems and software. Sold thru dealers)

C3 CONDUIT
P.O.Box 388
Iowa City, Iowa 52244

C4 CAP Electronics
1885 Shulman Ave.
San Jose, CA 95124
(408)371-4120

C5 Cap'n Software
P.O.Box 575
San Francisco, CA 94101
(415)841-6500
(415)848-6913

C6 Charles Mann & Associates
Micro Software Division
1926 South Veteran Ave.
Los Angeles, CA 90025

C7 Compumart
(micro div. of Newman Comp. Exch.)
270 Third St.
Cambridge, MA 02142
(617)491-2700

C8 C O M Press, Inc.
P.O.Box 102
Wentworth, NH 03282
(603)764-5831

C9 Computer Components, Inc.
6791 Westminster Ave.
Westminster, CA 92683

CA Capital Area Micro-computer Soc. (CAMS)
Box 348 Ridge Rd.
RD#1 Scotia, NY 12302
(518)372-3767
(contact: Stanley L. Mathes
SIG: TRS-80, Apple, others)

CB Commodore Business Machines
(PET/CBM)
3330 Scott Blvd.
Santa Clara, CA 95051
(408)727-1130
(a N.E. dealer is CM)

CC Connecticut Computer Club
c/o Leo Taylor
18 Ridge Court West A21C
West Haven, CT 96516
(203)933-5918

CD Creative Discount Software
256 South Robertson
Suite 2156
Beverly Hills, CA 90211
(800)824-7888
(800)852-7777 in CA
(800)824-7919 in AK,HI

CE CERC:Computer Education REsource Coalition
c/o TERC
8 Eliot St.
Cambridge, MA 02138
(617)547-3890

CH Computer Hobbyists of North Texas
P.O.Box 12498
Dallas, TX 75225
(214)268-0096

CL CLOAD Magazine
P.O.Box 1267
Goleta, CA 93017
(805)964-2761

CY Cybermate
RD#3, Box 192A
Nazareth, PA 18064
(215)759-6873

D1 DECUS
Digital Equip. Company Users Group
1 Iron Way
Marlboro, MA 01752
(617)481-7400

D2 Dilithium Press
P.O.Box 92
Forest Grove, Oregon 97116

D3 Digital Group Users Group
Box 316
Woodmere, NY 11598
Contact: Lloyd Kishinsky

D4 Digital Equipment Corporation
146 Main St.
Maynard, MA 01754

DG Data General
Route 9
Westboro, MA 01581
(617)366-8911

E1 Earl Keyser
22 Clover Lane
Mason City, IA 50401
(Pilot Exchange/Apple Exchange)

E2 Educational User Group
(for Compucolor and Intercolor)
Cathy Abramson
Marcus Publications
100 Northcreek
3715 Northside Parkway N.W.
Atlanta, GA 30327

EX Exidy (Data Products Div.)
390 Java Dr.
Sunnyvale, CA 94086
(408)734-9401

G1 Graham-Dorian Software Systems
211 North Broadway
Wichita, KS 67202
(316)265-8633

H1 Hayden Book Company, Inc.
50 Essex St.
Rochelle Park, NJ 07662
(201)843-0550

H2 Howard C. Best
International Data Service
340 West 55th St.
New York, NY 10019
(212)765-8610
(call person to person collect)

H3 Hug Northshore
88 Holten P.O.Box 112
Danvers, MA 01925
(617)774-2796
(Contact:Perry Miller
Conc:Heathkit H-9)

I1 Instant Software
Peterborough, NH 03458
(603)924-7296

I2 IRIDIS Magazine
Box 550
Goleta, CA 93017
(805)967-0905

I3 Intersell Inc.
465 Fairchild Dr. #214
Mountain View, CA 94043
(415)964-5460
(Mfgr. of Compucolor accessories and software)

I4 International Northstar Users Group
704 Solano Ave.
Albany, CA 94706
(415)527-7730
(Contact:J. Dvorak

I5 IMSAI
14680 Wick Blvd.
San Leandro, CA 94577

I6 Intel Corporation
3065 Bowers Ave.
Santa Clara, CA 95051

L1 Project LOCAL
200 Nahatan St.
Westwood, MA 02090

L2 Long Island Computer Assoc.
36 Irene Lane East
Plainview, NY 11803
(516)938-6769
(Contact:Aileen Harrison
Conc:8080,6800,TRS-80,KIM,
Software)

LE Lesley College
(Education Users Group:Susan Friel and Ricky Carter)
29 Everett St.
Cambridge, MA 02138
(617)868-9600
(Master's program in Educational Computing:Nancy Roberts)

M1 Micro Learningware
P.O.Box 2134
N. Mankato, MN 56001
(507)387-1649

M2 Micro Software Systems
Roy Busdiecker
P.O.Box 1442
Woodbridge, VA 22193

M3 Mad Hatter Software
Tim Quinlan
900 Salem Rd.
Dracut, MA 01826
(617)682-8131

M4 Michael Shrayer Software, Inc.
1253 Vista Superba Dr.
Glendale, CA 91205
(213)956-1563

M5 Milliken Publishing
1100 Research Blvd.
St. Louis, MO 63132
(314(991-4220

M6 MECC
(Minnesota Educational Computing Consortium)
2520 Broadway Dr.
Lauderdale, MN 55113
(612)376-1118

M7 Mountain Hardware, Inc.
300 Harvey West Blvd.
Santa Cruz, CA 95060
(408)429-8600

M8 MUSE Software
7112 Darlington Dr.
Baltimore, MD 21234
(301)661-8531

M9 Micro-Computer Business Users Group
161 W. 75th St.
New York, NY 10023
(212)580-3589
(Contact:Dr. Laird White[illegible]11)

MA Mini'app'les
13516 Grand Ave. South
Burnsville, MN 55337
(612)890-5051
(Contact:Dan Buchler, Pres.)

MN Micronet
Personal Computing Division
CopmuServe Incorporated
5000 Arlington Centre Blvd.
Columbus, Ohio 43220
(614)457-8600

MP Microphys Programs
2048 Ford St.
Brooklyn, NY 11229
(212)646-0140

MT Micro Technology Unlimited
Hal Chamberlain's Company
841 Galaxie Way
Manchester, NH
(603)627-1464

MV Mohawk Valley Micro-Computer Club
706 Lee St.
Rome, NY 13440
(315)339-2232
(Conc:8080/z-80)

N1 National Software Marketing
Elliot B. Kleiman
4701 McKinley St.
Hollywood, FL 33021
(305)625-6062

N2 Northern California Users Group
(Compucolor)
c/o Mark Newhamkin
Intersell (I3)

N3 NEECO
New England Electronics Company
679 Highland Ave.
Needham, MA 02194
(617)449-1760

N4 North Star Users Group
c/o The Software Works, Inc.
Box 4386
Mountain View, CA 94040
(408)736-9438

N5 New England Computer Society
P.O.Box 198
Bedford, MA 01730
(617)593-3154
(Contact:Dave Milton, Sect.
SIG: NECS Pet Users Group)

N6 New England Apple Tree
542 Concord Avenue
Lexington, MA 02173
(617)862-5096
(Contact:Ruth Souza, Secty.)

NE NEC
(Nypon Electric Company)
5 Militia Dr.
Lexington, MA 02173
(617(862-6415

NS North Star-Horizon
1440 Fourth St.
Berkeley, CA 94710
(415)527-6950

O1 Orange County TRS-80 Users Group
2531 E. Commonwealth Ave.
Fullerton, CA 92631
(714)738-0789
(Contact:Edward P. Faulk)

OS Ohio Scientific
1222 S. Chillicothe Rd.
Aurora, OH 44202
(800)321-6850

P2 Personal Software
592 Weddell Dr.
Sunnyvale, CA 94086
(408)745-7841

P3 PFDC Software/Recreational Programs
3500 Garden Oaks #128
Algiers, LA 70114
(504)362-4881

P4 Program Design Inc.
Carol Klitzner
11 Idar Court
Greenwich, CT 06830
(203)661-8799

P5 Programma International, Inc.
3400 Wilshire Blvd.
Los Angeles, CA 90010
(213)384-0579

P6 Programs for Learning
P.O.Box 954
New Milford, CT 06776

P7 The Program Manager
Chet Behrman
P.O.Box 45
Inglefield, IN 47618
(812)867-3524

P8 Programmers Software Exchange
2110 North 2nd St.
Cabot, AR 72023

P9 Pugetsound Program Library Exchg.
8710 Salty Drive N.W.
Olympia, WA 98502
(206)866-1500

PC Personal Computing
(Good Monthly)
Benwill Publishing
1050 Commonwealth Ave.
Boston, MA 02215
(617)232-5470

PL Petsoft Ltd.
5 Vicarage Rd.
Edgbaston
Birmingham, England
(U.S. distributor is P5)

PT University of Pittsburgh
Department of Computer Science
(Tom Dwyer & Margot Critchfield
of Project Solo)
322 Alumni Hall
Pittsburgh, PA 15260
(412)624-6475

R1 Rainbow Computing Inc.
9719 Reseda Blvd.
Northridge, CA 91324
(213)349-5560

R2 Rhode Island Computer Hobbyists
Box 599
825 Hope St.
Bristol, RI 02809
(401)253-5450

R3 Rochester Area Microcomputer Society
(RAMS)
P.O.Box D
Rochester, NY 14609
(716)473-3184
(Contact:Erwin Rahn
Conc:S-100,6800,8080, Homebrews,
North Star,TRS-80,Apple)

R4 Rochester Area Users Group
c/o Ben Barlow
161 Brookside Dr.
Rochester, NY 14618
(716)385-2969
(Compucolor exchange library, over 700 programs, 12 disks)

R5 Rockland County Compucolor User Group
c/o Ronnie Schnell
17 Eckerson Lane
Spring Valley, NY 10977
(914)352-8069

RS Radio Shack
1800 Tandy Center
Ft. Worth, TX 76102
(817)390-3021

S1 School District of Philadelphia
Henry R. Altschuler, CIA
Instuctional Systems
5th & Luzerne Streets, 5th Floor
Philadelphia, PA 19140

S2 Softape Software Exchange
10756 Vanowen St.
North Hollywood, CA 91605
(213)985-5763

S3 Softsell Unlimited
P.O.Box 145
Lithonia, GA 30058

S4 The Software Stockpile
9434 Ironwood
Des Plains, IL 60016

S5 San Diego Computer Society
P.O.Box 81537
San Diego, CA 92138
(714)421-9377
(714)278-4284

S6 Sorcerer's Users Group
Computer Mart
1395 Main St.
Waltham, MA 02154
(617)899-4540

S7 THE SOURCE
1616 Anderson Blvd.
McLean, VA 22102
(703)821-6660

S8 San Diego County Users Group
c/o Jim Helms
4888 Ronson Court Suite H
San Diego, CA 92111
(714)565-7283
(Thousands of Compucolor programs, 31 disks Available.)

SD Software Directory
Robert E. Purser
P.O.Box 466
El Dorado, CA 95623
(Excellent, comprehensive directory of all T8, A2, P1, AT programs. Issued quarterly $12 per year.)

SE Southeastern Software
7270 Culpepper Dr.
New Orleans, LA 70126
(Good Apple Newsletter)

SP Stan Pro
(S.P. Electronics)
5250 Van Nuys Blvd.
Van Nuys, CA 91401
(213)788-8850
(Compucolor/Intecolor Users Group as well as dealer and manufacturer)

SR SRA
Science Research Associates
155 N. Wacker Dr.
Chicago, IL 60606
(312)984-2000
(Educational publisher. Developing CAI for Atari 800 computers.)

T1 TERC
Technical Educational Research Cntr.
8 Eliot St.
Cambridge, MA 02138
(617)547-3890

T2 Toronto & Associates
P.O.Box 6073
San Rafael, CA 94903

T8 TRS-80 Software Exchange
Roger W. Robitaille
P.O.Box 68
Milford, NH 03055
(603)673-5144

TB TRS-80 Business Club of Arlington
96 Dalton St.
Arlington, MA 02174

TI Texas Instruments, Inc.
P.O.Box 225474
Dallas, TX 75265
(214)238-2011

TU TRS-80 Users Group of
Eastern Massachusetts
61 Lake Shore Rd.
Natick, MA 01760
(617)653-6136

U1 University of Michigan
Center for Research on Learning
and Teaching
Karl L. Zinn
109 East Madison St.
Ann Arbor, MI 48104

U2 Unicom
297 Elmwood Ave.
Providence, RI 02907
(800)556-2878
(Bell & Howell, Apple, AMF,
Courseware)

W1 Russ Walter
92 St. Botolph St.
Boston, MA 02116
(617)266-8128
(Expert on computers and programming.
Gives advice on phone at all hours.
Author of several books.)

W2 Wang Laboratories
1 Industrial Ave.
Lowell, MA 01851

W3 Warner Communications
75 Rockefeller Plaza
New York, NY 10020

MS Microsoft Consumer Products
10800 Northeast Eighth, Suite 819
Bellevue, WA 98004
(206)454-1315

STATE OF CONNECTICUT
STATE DEPARTMENT OF EDUCATION
Box 2219 — Hartford Connecticut 06115

TEL 566-2169

To: Math/Computer Teachers in Connecticut

From: Steven Leinwand, Math Consultant

Re: Attached Computer Survey

The attached survey of "Computers in Connecticut Public Schools" attempts to fill a frequently noted void by providing information on computer availability. It is a small st toward meeting a personal goal of significantly increasing the access and exposure of Connecticut's public school students to computers.

In our continuing efforts to achieve this goal, I once again ask for your assistance. I would appreciate your sending me 1) copies of course outlines and/or objectives that you may be using in computer science, computer programming or related courses, 2) information on any errors, omissions or additions to the attached survey and 3) any suggestions for additional data that should be collected on future surveys.

I hope that you find the computer survey a useful document and I thank you again for providing the data.

Connecticut State Department of Education
Division of Instructional Services
Bureau of Elementary and Secondary Education
Hartford

COMPUTERS
in
CONNECTICUT PUBLIC SCHOOLS
1979

A SURVEY

Steven Leinwand
Mathematics Consultant

Connecticut State Department of Education
Division of Instructional Services
Bureau of Elementary and Secondary Education
Hartford

COMPUTERS IN CONNECTICUT PUBLIC SCHOOLS 1979

I. Introduction

In the fall of 1979, a survey form was sent to 117 mathematics supervisors and department chairpersons. The 117 surveys represented all cities or towns with a public high school and requested information about computer availability and usage in the high school(s) in that community, as well as in the elementary and middle/junior high schools in that community or other communities that "feed" into the high school(s). In this fashion, an attempt was made to cover all K-12 public schools in Connecticut.

Data were collected from all 117 towns. Ninety-three forms (80%) were returned and telephone calls were made to the remaining 24 school districts for information. Given the limitations of this procedure, the data should be viewed as more representative than all-inclusive.

Hopefully, the survey data will be used in several ways:

- to provide baseline figures from which to monitor the growth of computer availability and use,
- to encourage the sharing of programs, in both the broad sense and the specific computer sense, among schools with similar hardware and to assist in breaking down the often expressed isolation of educational computer users, and
- to provide data or "ammunition" for those districts attempting to justify the initiation or improvement of instructional use of computers.

As we enter the 1980's, the data demonstrate that computers of one kind or another are available for student use in a significant number of Connecticut's high schools. However, we face several challenges in our ongoing efforts to integrate a computer literacy strand into school curricula:

- increased access to computers in our elementary and middle/junior middle schools,
- development and sharing of model computer literacy, computer science and computer programming objectives and activities,
- improved courseware for computer assisted instruction and better means for sharing this courseware, and
- activities that promote computer usage within appropriate units of traditional mathematics, science and business education courses.

It is hoped that the survey data will be of some assistance as schools move ahead to meet these challenges.

II. Elementary Schools

Computers are available for student use in 44 elementary schools in 15 towns in Connecticut. This equipment is used primarily for enrichment and/or with academically gifted pupils. However, some districts, with larger computing systems, are beginning to utilize computer assisted instruction (CAI) as part of a remedial assistance program.

TABLE 1
COMPUTER AVAILABILITY IN ELEMENTARY SCHOOLS

Radio Shack TRS-80	Apple II	Other
East Granby (1 school out of 1)	Bridgeport (1-34)	Danbury (TI-80 in 2-11)
Lebanon (1-1)	Fairfield (1-12)	Greenwich (terminals in 11-11)
Orange (4-4)	Guilford (4-4, one machine shared)	Hartford (terminal in 1-24)
Watertown (1-4)	Stamford (1-16)	Ridgefield (terminals in 3-6)
Regional #15 (1-3)		West Hartford (terminals in 11-11)
		Westport (terminal in 1-6)
8 schools in 5 towns	7 schools in 4 towns	29 schools in 6 towns

TOTAL: 44 schools in 15 towns

III. Middle/Junior High Schools

Computers are avaiable for student use in 33 middle/junior high schools in 24 towns in Connecticut. This represents 20% of the 166 middle/junior high schools in the state. As is the case at the elementary level, this equipment is reported to be used primarily for enrichment, although several school districts are informally teaching programming, while others use the equipment for remedial assistance.

TABLE 2
COMPUTER AVAILABILITY IN MIDDLE/JUNIOR HIGH SCHOOLS

Radio Shack TRS-80	Apple II	Other
East Granby (1 school out of 1)	New Fairfield (1-1)	Berlin (PET, 1-1)
Ellington (1-1)	Watertown (1-1)	Canton (terminal to high school, 1-1)
Lebanon (1-1)	Weston (1-1)	Danbury (TI-80, 2-2)
Middletown (1-2)		Darien (terminals to high school, 2-2)
Torrington (1-1)		Farmington (terminal to high school, 1
Vernon (1-1)		Greenwich (terminals to system computer, 3-3)
Wilton (1-2)		Hartford (terminal to system computer 2-2)
Regional #7 (1-1)		Monroe (terminal to high school, 1-1)
		Shelton (terminal to high school, 1-1)
		West Hartford (terminals to system computer, 2-2)
		Westport (PDP 8, 3-3)
		Regional #5 (terminal to high school, 2-2)
		Regional #12 (terminal to WCSC, 1-1)
8 schools in 8 towns	3 schools in 3 towns	22 schools in 13 towns

TOTAL: 33 schools (20%) in 24 towns

IV. High Schools

Computers are available for student use in 123 (88%) of Connecticut's 140 public high schools. This represents 102 of the 117 towns with one or more public high schools. Available hardware ranges over a broad gamut from microcomputers to minicomputers and from time-sharing teletype hookups to on-line terminals run off of large computers operated by the district or the town. (see Table 5)

The most commonly stated use of computers at the high school level is for programming instruction as part of computer science or computer programming courses. Other, less frequently stated, uses include: enrichment, problem-solving, data processing, computer awareness, computer assisted instruction, and remedial assistance.

Access to the computers varies from all students to just those students enrolled in appropriate courses. Several schools limit access during school hours to certain students and remove any restrictions during after school hours. (see Table 3)

Further, in an overwhelming majority of districts, primary responsibility for the computers lies with the mathematics department. However, the science and business education departments, as well as the administration often share the equipment. (see Table 4)

Finally, based upon approximate enrollment data supplied for 99 out of the 123 schools with computers, nearly 6300 high school students are enrolled in a computer programming, computer science, data processing or closely related one or two semester course during the 1979-80 school year.

TABLE 3
ACCESS TO COMPUTERS IN HIGH SCHOOLS*

Access for:	Number of Districts
only students in certain classes	43 (51%)
all students	33 (40%)
only students in certain classes during the day, all students after school	3 (4%)
all juniors and seniors	1 (1%)
all students after completing algebra I, algebra II, or algebra I and geometry	3 (4%)
	83 (100%)

TABLE 4
PRIMARY RESPONSIBILITY and DEPARTMENTAL USE OF COMPUTERS IN HIGH SCHOOLS*

	Math	Science	Business Ed.	Administration	Other
"What department has primary responsibility for computing equipment?"**	74 (89%)	5 (6%)	8 (10%)	6 (7%)	0
"What departments make use of computing equipment?"	83 (100%)	40 (48%)	32 (39%)	26 (31%)	16*** (19%)

* Based upon surveys returned from 83 towns (99 high schools) reporting computers present
** Total is greater than 83 (100%) because of shared primary responsibility.
*** Other: Guidance 6 (7%), Social Studies 4 (5%), English 3 (4%), Foreign Language 2 (2%) and Reading 1 (1%).

TABLE 5
COMPUTER AVAILABILITY IN HIGH SCHOOLS

Radio Shack TRS-80	Apple II	Wang 2200	DEC PDP 8	DEC PDP 11/03	DEC PDP 11/34	Other
Ansonia	East Granby	Berlin	Bloomfield	Ledyard	Darien	Avon (time share with Talcott Mtn. science Center)
Bethel	East Lyme	Canton	Groton	Trumbull	East Windsor	Branford (Data General)
Derby	New Fairfield	Clinton	Guilford	Waterford	Farmington	Bridgeport (terminals to IBM 2741, 2 schools out of 3)
East Haven	Norwalk (2)	Newtown	Hamden	Westbrook	New Canaan	Bristol (terminals to NCR) (2)
Ellington	South Windsor	Vernon	Hartford (2-3)	Wolcott	Shelton	Brookfield (Wang WCS 30)
Glastonbury	Stratford (2)	Watertown	Litchfield	5 schools in 5 towns	Simsbury	Cheshire (Alpha Micro CPE)
Griswold	Weston	6 schools in 6 towns	Meriden (2)		Regional #9	Cromwell (Wang)
Lebanon	Westport		Monroe		Regional #13	Danbury (terminals to Wang)
Milford (2 schools out of 3)	Regional #10		Naugatuck		Regional #15	East Hampton (Data General Nova 2)
Newington	Regional #17		New Britain (2)		9 schools in 9 towns	East Hartford (terminals to IBM 370) (2)
Plymouth	12 schools in 10 towns		New Haven (3)			East Haven (terminals to Yale APL)
Rocky Hill			New Milford			Enfield (Data General Nova 2) (2)
Seymour			Old Saybrook			Fairfield (Wang and IBM) (2)
Somers			Plaiville			Greenwich (terminals to Hewlett-Packard)
Southington			Rocky Hill			Hartford (terminals to DEC PDP 20/20) (3)
Stafford			Stamford (3)			Madison (Burroughs)
Stonington			Thompson			Manchester (terminals to IBM 370)
Tolland			Torrington			Milford (Monroe 1880) (1-3)
Wilton			Wallingford (2)			Montville (North Star)
Windham			Wilton			North Branford (Time Share Corp.)
21 schools in 20 towns			Windsor			North Haven (terminals to Yale APL)
			Regional #1			Norwalk (Hewlett-Packard) (2)
			Regional #4			Portland (Wang)
			Regional #5			Ridgefield (Hewlett-Packard 2100A)
			Regional #7			Thomaston (Wang PCS-4)
			Regional #14			Waterbury (Burroughs TC 3600, TC 3800 terminals to Waterbury Hospital) (3)
			34 schools in 26 towns			West Hartford (terminals to Hewlett-Packard) (2)
						West Haven (DECwriter to ACES)
						Westport (Hewlett-Packard 9830)
						Wethersfield (Educomp LSI)
						Windsor Locks (HeathKit)
						Regional #12 (terminals to WCSC)
						Regional #18 (Compucorp Desktop)
						44 schools in 33 towns

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TOTAL: 131 schools in 109 towns
less 8 schools in 7 towns double counted*
= 123 schools in 102 towns
(88%)

*East Haven, Hartford (2), Milford, Rocky Hill, Norwalk (2), Westport, Wilton

No Comupters: Bridgeport (1 school out of 3), Bolton, Colchester, Coventry, East Haddam, Granby, Killingly, Middletown (2), New London, North Stonington, Plainfield, Putnam, Suffield, Regional #6, Regional #8, Regional #11.
TOTAL: 17 schools in 16 towns.

Department
of
Educational and Cultural Services

SAMPLE A40

J. Gary Nichols
State Librarian

FEB 13 1980

MAINE STATE LIBRARY
MEDIA SERVICES
LMA BUILDING
STATE HOUSE STATION 64
AUGUSTA, MAINE 04333
TEL. (207) 289-2956

January 11, 1980

Dear Principal:

Each year it is necessary for us to acquire information from schools to determine the effectiveness of Instructional Television. Statistics provided by schools not only justify the existence of ITV, but aid in helping improve the services.

This year would you please distribute teacher survey forms to your staff and *return them in the same envelope* in which they arrived, using the mailing label provided. This system should be more convenient and it also recycles the envelopes.

We ask that you or someone on your staff please answer the questions below and return the form along with teacher's responses.

Thank you for your cooperation.

Sincerely,

John W. Boynton

John W. Boynton
Coordinator, Media Services

Orono H.S. | R. Robinson | Jeannie Gamage Librarian
SCHOOL | PRINCIPAL | NAME OF PERSON COMPLETING FORM

1. Please indicate the total number of students viewing Instructional Television during the 1979 80 school year. (Include those viewing videotapes as well as public television.) 500

2. If ITV is not used, please indicate the reasons Does not coincide with class schedules

3. Would you prefer to handle information from this office regarding Instructional Television or would you rather name someone on your staff to serve as ITV Coordinator? ☐ Prefer to do it myself ☐ Prefer to name an ITV Coordinator

4. Do students in your school have the use of a computer as a learning tool? ☒ Yes ☐ No

5. If you have a computer, is it connected to a larger computer system (University, bank, etc.) ☒ Yes ☐ No

6. If you have a small computer, please list the *brand name and model*

FOR INFORMATION CONTACT:
Jack Boynton 289 2956
CF:L-811
January 1980

PLEASE RETURN TO:
John W. Boynton, Coordinator
Media Services
Maine State Library
LMA Building
State House Station 64
Augusta, Maine 04333

NO LATER THAN FEBRUARY 15, 1980

Orono High School	A41	Terminal
Lincoln Academy, Newcastle		Polymorphic
Rumford High School		6 - PETs
Caribou		Terminal
Oxford Hills H.S., South Paris		Programmer 101
Woodwich Central School		TRS-80
Madawaska High School		TRS-80
Asa Adams Elementary, Orono		TRS-80
Yarmouth High School		Digital
Morse High School, Bath		PDP 11/03
Fryeburg Academy		Olivetti P602
Washburn Elementary		TRS-80
Massabesic High School, Waterboro		PDP-8
Van Buren System		Wang PCS 2
Bucksport High School		TRS-80 w/printer
Scarborough Jr. High		Terminal
Bucksport Jr. High		TRS-80 16K
Cony High School, Augusta		Univac 7200 and PDP-11
Stearns High School, Portland		TRS-80
Georges Valley High School, Thomaston		TRS-80
Gray/New Gloucester Jr. High, Gray		PDP-8
Jefferson Village School		TRS-80
Edward Little High School, Portland		Yes
Hermon High School		Terminal
Mattanacook Academy, Lincoln		TRS-80
*Berwick Academy		3-TRS-80's Level II
Union Elementary		TRS-80
Bath Jr. High School		2-TRS-80's
*Keats Hill School, Readfield		Apple and IMSAI w/printer

*Thornton Academy, Saco	PDP-8
Jonesport High School	TRS-80
Brewer High School	PDP-8
York Middle School	(Planning 3)
Ft. Fairfield High School	TRS-80
*Waynflete School, Portland	PDP-8
Sanford High School	PDP-8
Manchester Elementary	Yes

* - Private schools

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PLANNING COMMITTEE FOR
REGIONAL COMPUTER ORIENTED TEACHER CENTER

RESULTS OF SURVEY CONDUCTED IN FEBRUARY 1980

(EASTERN MASSACHUSETTS)

Dear Teacher:

Computers of all kinds are being used increasingly in schools to augment instruction. We enthusiastically support this trend, but feel that, in order to be successful, it must be accompanied by more resources than appear to be available to most teachers. Accordingly, we are trying to initiate the development of a teacher center, focused in the area of computer oriented instruction, to serve towns west of Boston. Please help us by answering the following questions and returning the form (SASE enclosed). Please be prompt as we are working against a dead line. Thank you.

Your Name_____ School_____

1. To what extent are the following services needed by you, your fellow teachers, and students in your district (check appropriate columns for each).

Note: 46 persons from about 21 school systems completed the questionnaire.

	Proportion Col.1 or Col.2	A Great Deal	Some	Little or Not At All
a. Consultation re: curriculum, hardware, software.	91% 85%	28	14	4
b. Central library of periodicals, textbooks.		23	16	7
c. Central library of computer related AV materials.	85%	26	13	7
d. Mobile library	46%	11	10	9
e. Training				
General orientation	74%	17	17	6
Programming	78%	17	19	4
How to use computer in teaching. Subject_____?	83%	23	15	4
Computer in classroom management	54%	11	14	9
Other subject_____.				
f. Dial-up, computer based bulletin board for resource sharing.	63%	12	17	8
g. Instructional computing hot line.	61%	10	18	11
h. Newsletter with info about what's going on here and elsewhere, book reviews, etc.	89%	29	12	3
i. Speakers bureau-experts in particular areas, computer occupations, etc.,	54%	16	19	9

TEACHER CENTER QUESTIONNAIRE (cont.)

	Proportion Responding Col.1 or Col.2	(1) A Great Deal	(2) Some	(3) Little Or Not At All
j. Interest group seminars, meetings.	87%	16	24	6
. Cooperative purchasing-hardware, supplies	70%	14	18	10
l. Product demonstration center, hardware and software.	89%	19	22	5
m. Software directory.	89%	29	12	4
n. Published software evaluations.	91%	30	12	4
o. Software exchange (sharing of locally created).	91%	33	9	3
p. Software development services.	89%	26	15	5
q. Software translation (one computer to another).	82%	20	17	8
r. Publication of teacher-made software.	91%	24	18	3
s. Student placement service, computer-related jobs.	74%	18	16	8
t. Education/industry interface for computer-related concerns.	72%	17	16	9

2. Please estimate the number of instructional computer work stations (keyboards) in your school system now and next year.

	Average No. Per System Now	1980-81	Average Increase
Time-sharing terminals	6.4	7.4	4.1%
Microcomputers	4.9	9.0	158.3%
Total	11.3	16.4	46.9%

3. Please use the remaining space to make any additional comments you wish regarding your own special interests or needs.

STATISTICS REGARDING NUMBER OF STUDENT WORK STATIONS

Note: Data is for 20 school system.

	N O W		1980 - 1981		Avg.
	Total	Avg./System	Total	Avg./System	Per cent Increase
Time-sharing Terminals	127	6.4	131	7.4	4.1
Microcomputers	97	4.9	180	9.0	158.3
Total	224	11.2	311	15.6	46.9

PERSONS WISHING TO HELP, TEACHER CENTER SURVEY

Nancy Gouveia - Thompson School -

Chet Zwonik, Loker School Wayland

Joseph P. Lukis, Wayland High School

Peg Bondorew - Diamond Jr. H.S. , Lexington

Robert E. Couture - Dover-Sherborn Public Schools

Jim Casey, Concord Middle School (Peabody Building).

Mr. Krishna Narayan, Framingham North High School

COMMENTS ON TEACHER CENTER SURVEY

1. Development of Test Item Bank for Computer Literacy including proficiency in BASIC programming.

2. This is a wonderful idea and I'd love to help. Also, I'd like to interview you sometime about the kinds of things you do.

3. I am most interested in elementary. Please call me if I can help.

4. If I can be of further assistance, please contact me. Right on!

5. We are just getting started, after a period of several years of almost no computer activity at the school Primarily, we are interested in computer curricula developed in other schools.

6. A central location for computer information is needed very much. Project LOCAL has provided many services, but we need to share among a large number of school systems. At this point in time there is much duplication of effort and resources which is costly in time and hours.

7. The lack of progressive programmed instruction (entire units in one area) limits the use of the computer in our school more towards fun and games as oppose to instructional use.

8. I am speaking as a biology teacher, not for the school! Project LOCAL has been very cooperative, but I feel there is a NEED for interesting and useful software. We would love to have some microcomputers available so the whole class could use the computer at one time.

9. We have been associated with Project LOCAL for many years. WE have the services listed above.

10. Currently Needham system is connected with Project LOCAL (Westwood) but will not be next year.

11. Maybe the upcoming cable TV system coming into Newton can be used as a network of communication between schools. Does anyone have the expertise to look into this possibility.

12. Good luck tabulating all these!

13. Our system (2 Jr H's and 1 S.H.) is starting to grow in the use of computers At the J.H. we are looking for ways to utilize computer in our curriculum. We are interested in in-service, or summer workshop type training for staff.

14. You seem to have covered things very well. But remember that the dissemination of information (bulletins, etc.) through some common computer system (as seems to be implied in a few things above) is probably impossible since so many school are using in-house mini or microcomputers.

15. What about Project LOCAL? They are already on the road with many of these services. This sounds like a tremendous idea - let me know if I can help in this endeavor in any way (teacher center).

16. My concern is computer-assisted instruction which does more than replace workbooks and objective exams, and a teacher with a machine. The creative, positive, and unique ways in which students may interact with the computer in

(cont)
16. education are of top priority.

17. Present use PET 2001 microcomputers and develop own software for games and CAI in chemistry courses (inc. labs). I'm interested in results of your work.

18. We're applying for several federal grants which may enable us to move ahead much faster.

19. I'm delighted that you are organizing this. Let me know if we can help in any way . . .

20. If I can help I would be interested in helping out.

21. A needed development - Good luck!

22. I had trouble discriminating among the response choices. Virtually all are excellent ideas. My "somes" generally indicate we are doing some small thing about it in Brookline. Needs on all are "a great deal" "some"are partially satisfied. We have a long way to go though.

23. Information, discussions, speakers, etc. relating to computers and human values; overview of the future of computers in society.

Help with long range planning.

24. a. I am practicularly interested in finding graded (easy to difficult) programs which are business oriented using COBOL and for FORTRAN IV.

b. I would like a listing of successful teaching aids (sources filmstrips, transparancies, etc.) for an introductory computer course.

c. I am looking for definitive textbooks for:
(1) an intro course
(2) a FORTRAN IV course
(3) a COBOL course

25. I am very interested in full time (or part time) programming (especially scientific but not necessarily). I prefer to work at home - I also would be interested in teaching or participating in your planned teaching activities.

26. Need for educational software written for average students and field tested for usefulness in schools other than the "super schools", e.g., the P. Andover and Exeter Academies, St. Paul's etc.

27. Most programmers write poor educational programs. Most teachers write poor programs. What your're attempting to do should address this as a major issue. It is a difficult task.

28. Finding good software for math is a problem. Would like to hear more about your committee.